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A Year's Export Trade.

A month ago we stated in this column that judging from appearances, the electrical export trade of the country would reach over $12,000,000. The figures are now available for the whole of 1905, and we are glad to note that they substantiate the prophecy. The exports of electrical appliances, including telgraph and telephone instruments, reached a total of $5,648,435; and the exports of electrical machinery amounted to not less than $7,409,242. The aggregate is $13,057,677. This compares with a grand total in 1904 of $11,039,758, or a gain of $2,017,919, or about 20 per cent. Such a condition of affairs is healthy and encouraging, and shows that the export of electrical goods from America can be made successful if steadily and intelligently pushed. Part of the increase may be due to the higher cost of material, such as copper, but the figures as a whole reflect genuine gains. This is the more notable because so many American electrical manufacturers have factories or arrangements for the production of their apparatus abroad. An analysis of the returns shows that England and her colonies colonies remain our good friends. Of electrical machinery British North America took $2,023,914; the United Kingdom, $885,095; British Australasia, $252,028; British Africa, $161,449; British East Indies, $109,944. Wherever the English flag flies a similar welcome awaits our goods. We also have generous patrons in Japan to the tune of $1,239,878, and excellent customers in Mexico to the extent of not less than $1,057,023. South America generally was good for about $500,000. The figures of electrical instruments are not subdivided geographically in the returns, but they follow broadly the same lines of distribution, and show a very universal widespread appreciation of American electrical products.

Rain or Snow Velocity a Possible Limiting Factor in Wireless Telegraphy Range of Transmission.

The article by Capt. Wildman, on page 320 of this issue, suggests very pertinently that the weather at a sending station may have a distinct influence upon the strength of the signals at the receiving station. He bases this suggestion upon a record which shows both the wind velocity by anemometer and the relative weakness of received signals at the same receiving station in Alaska. It is to be supposed that the wind at the distant sending station matched that recorded at the receiving station. There seems to be a general agreement in the record between the two curves, going to show that when the wind velocity was marked the weakness of the signals was also marked. Nevertheless, this does not seem to have been always the case, if we may judge by the deviation between the curves under the date of November 3. It is quite conceivable, however, that when snowflakes or raindrops are being driven in large numbers across the sending mast wires by a high wind, that the potential of the waves thrown up the wires would be reduced. The effect would probably be greater for snow than for rain, because rain having a much lesser surface per unit mass than snow, is apt to have a more nearly vertical trajectory, and so a rain stream would not be intersected by the wires so much as a snow stream, in a given horizontal wind

velocity. If this reasoning is sound, the weather conditions in Alaska are more likely to be unfavorable to the sending station than they are in more genial and more customary latitudes. In any case it would only mean that more power would have to be employed in the sending aerial during a snowstorm than under clear skies.

Power Plant Economics.

We have been much interested in the consideration of Mr. Stott's Institute paper upon this fruitful theme, an abstract of which appeared last week. That the economics of power plants can be very greatly improved is a point beyond argument—the mere analysis of the losses makes the present situation clear. But in what direction one should work for improvement is not so fully evident, and we must admit that Mr. Stott's discussion of the matter does not, through any practical suggestions, give us much light on the subject. Certain facts stand out very prominently, as they have for a long time past, but the improvements suggested do not carry the weight that comes from well defined experimental data. To begin at the beginning, there is considerable room for gain in the matter of boilers and furnaces. The ultimate test of operative economy is the coal required per kilowatt-hour at the switchboard, and the first thing in a programme of reform is to see that the coal is forced to make steam efficiently. As Mr. Stott very truly remarks, the difference in ultimate efficiency between well designed boilers of various types is not great. The criticism, however, can be offered upon all the types in common use, that the units are inconveniently small. In these days of large plants, we find in the generator room direct-coupled units of so great individual output that there is very little needless reduplication. Step, however, into the boiler room and you find "batteries" of small boiler units, with correspondingly small furnaces, taking up a large amount of space, requiring a complicated system of piping and causing large additional expense which reacts seriously upon the fixed charges and maintenance.

When one is using 5,000-kw generating units, it would certainly appear to be good policy to use much larger boiler units than ordinary, with furnaces and mechanical stokers to match. The result of such increase should be the minimizing of incidental losses, a material increase in boiler efficiency, and a very considerable reduction in operating and fixed charges. When it comes to a consideration of prime movers, the situation just at present is chaotic. We agree with Mr. Stott that the coming of the steam turbine has been a good thing. Whatever its final place in the art may be, it has made no inconsiderable place for itself already and is serving as a valuable stimulant to prime-mover design in general. It came at a time when engine-building had sunk into a complacent period of standardization, and it has not even yet shocked the engine builder into full activity, at least in this country. We think that Mr. Stott errs in ascribing the efficiency which he does to steam turbines as they now are. The figures he quotes are not to our knowledge justified by any tests made *in situ* after, let us say, a year of commercial operation, and in fact they are not within a good many per cent of any such tests. Very few commercial turbine tests would show better than 20 lbs. of steam per kw-hour including all the auxiliaries. No turbine tests of any kind, even when made *ex parte* in the shops, have shown the thermal efficiency reached not infrequently in the tests of some reciprocating engines using superheated steam. On the superheat in commercial use abroad and with proper condensation, it is feasible to deliver the kw-hour at the switchboard on the consumption of less than 15 lbs. of steam used in reciprocating engines. Until the turbine is prepared to meet some such figure commercially, it must depend for its popularity on virtues other than extreme economy. As to the advantage claimed for the turbine with respect to high superheat, it should not be lost sight of that the multiple-expansion reciprocating engine can in its several stages utilize a high aggregate charge; and as to high vacuum, it is yet to be demonstrated whether there is any final commercial economy in the extra inch or thereabouts that may be utilized with the turbine.

That the steam turbine has virtues is undeniable, but Mr. Stott's table—based on assumed turbine efficiency not confirmed in practice, as compared with a very modest reciprocating engine efficiency which has been repeatedly surpassed—is for these reasons a most fallacious guide. If he had taken his turbine consumption at 20 lbs. per kw-hour and his engine at 15 lbs. per kw-hour, an hypothesis certainly as well justified as the one he actually used, the finai summation would have taken on a very different appearance; and if he had had actual experiments with his proposed low-pressure turbine, we are inclined to think that his proposed economy would never have been suggested. And it should be noted, in addition, that the familiar assumption of bad engine efficiency at partial loads is not borne out by the facts when the engine is probably designed for high pressure and superheat. A reciprocating engine undeniably has higher friction than a turbine, but even so, as in the famous engine tests in England last year, it may easily have at partial loads an efficiency far below anything ever recorded for a turbine. When Mr. Stott can find a turbine for low pressure, or any pressure for that matter, capable of giving the brake hp-hour at half load on less than 10 lbs. of steam, he may consider himself lucky. On any present showing we cannot take his exhaust turbine plan very seriously. Nevertheless, the steam turbine has enough efficiency taken in conjunction with its great compactness, freedom from vibration, ease of operation, and general convenience, to justify extensive use, especially since direct-current turbo-generators are now available; and if our American engine builders do not busy themselves with improvements they will find cause for repentance, and that at no late day.

The gas engine situation is somewhat of a different matter. The engine itself is undeniably far more efficient than any form of steam motor has any reasonable chance of being, and the question of its general utility in power plants turns on entirely different causes. As Mr. Stott admits, the earlier difficulties of bad regulation, uncertainty of action and large maintenance have in great measure been overcome, leaving as the principal objection the inability to carry overloads. There is, however, a relation between what one is pleased to call full load and the rating of the engine. With a given gas engine there is a certain point of output that cannot be exceeded, just as there is in a steam engine with a fixed maximum cut-off, as in many Corliss engines. The "overload" capacity of the engine depends on how near to this maximum one cares, in view of working economy, to rate the machine. The 400-hp gas engine of Mr. Stott's paper has substantially the same thermal efficiency on the basis of brake horse-power at 300 as at 400 hp. On the latter rating, it has practically no overload capacity but excellent efficiency between half load and full load. At a 300-hp rating it would be said to have a good overload capacity with remarkable efficiency, but

considerable losses when worked below three-quarters overload. Anything that helps the low load efficiency of the internal combustion engine practically helps its overload capacity, as in the case of other prime movers; and when large gas engines are turned out in a quantity, the cost per rated horsepower will still be reasonable at a conservative rating. We had hoped ere this that the first of the great gas engine units of the California Gas Electric Co. would have been put into operation, but the event has been delayed, so that it may be several months before results from this notable plant are available. Until such large work has been done, the issue as regards internal combustion engines will remain somewhat obscured. As to the other rivals, the turbine contingent seems for the moment at least to have the engine men somewhat on the defensive, to put it mildly. American engine builders have been very slow to take advantage of high superheat and great expansion, and even in the face of turbine competition, a request for engines built up to advanced foreign practice in these particulars usually meets a very cool reception. The frequent loss of large contracts ought to spur them into a course of active improvement; if not, let their sorrows be upon their own heads—the makers of turbines will not weep for them, and builders of power stations will extend them meagre sympathy.

A STANDARD KILOWATT FOR METER TESTS.

There is a well-known difficulty in determining the constant of a watt-hour meter connected with a variable line pressure. If the voltage between the mains is so nearly steady that it can be regarded as constant, the testing of a registering watt-hour meter on customer's premises is not a difficult operation. The usual plan, in this country, is for the tester to carry about with him a portable form of rheostat load, and either a standard wattmeter or a voltmeter and an ammeter. The time occupied in making a definite number of revolutions is carefully noted for the meter under test, when the known portable load is applied. A table then shows whether the meter is fast or slow. If, however, the voltage across the mains is very variable, and the range of variation is, say, from 5 per cent above normal to 5 per cent below, then the load on the meter with a constant rheostat in circuit will vary from about 10 per cent above normal to 10 per cent below, and it is difficult to assign the quantity of energy which has passed through the meter, within several per cent.

Dr. Martin Kallmann has recently published an article upon this difficulty in the *Elektrotechnische Zeitschrift,* an abstract of which appears in the Digest. He describes a form of portable rheostat which automatically maintains a nearly constant load on the meter tested, despite 5 per cent pressure variations in the mains above or below the normal. The gist of the contrivance is in the employment of ballast wire, of the same character as is used in a Nernst lamp. As is well known, the glower of a Nernst lamp is electrically unstable on constant-potential circuits, and the expedient is adopted of inserting in the glower circuit a glass-enclosed resistance of iron wire, in nitrogen or other inert gas. The iron wire is worked at a current density sufficient to raise it to a dull-red temperature. At this temperature the variation of the resistivity of iron is very rapid, so that a 1 per cent increase in current strength may increase the resistance of the glowing iron wire by 15 per cent. A suitable amount of this sensitive ballast resistance, in circuit with the glower, renders the combination electrically stable, at the expense of a slight drop in pressure at glower terminals. In a similar manner Dr. Kallmann employs a number of these ballast glow-tubes in parallel with each other, a suitable group of such tubes being connected in series with the resistance of manganin, or other constant-resistivity alloy. The ballast glow-tubes then serve to absorb nearly all of the variations of pressure in the mains, provided that the latter do not exceed, say, 5 per cent of the normal. This leaves both the current and the drop in the alloy resistance very nearly constant. The meter to be tested is loaded by being connected in series with the alloy resistance, and in parallel with the drop of pressure across the same.

If, for example, the mains had a normal pressure of 220 volts, the coil and ballast would be so proportioned as to take 5 amperes, or 1,100 watts, from the main at this pressure. There would be, say, 10 ballast tubes in parallel, all working at dull-red heat. The drop in the ballast would be 20 volts, leaving 200 on the coil with 5 amperes and 1 kilowatt developed therein. If now the main voltage should rise to 230, it is reported that the ballast would drop about 28.5, leaving 201.5 volts on the coil, with 5.038 amperes and 1,015 watts developed in it. That is to say, the power liberated as heat in the coil would increase only 1.5 per cent, when the main pressure increased 5 per cent; whereas, without the ballast compensation, the power in the load would have increased 10 per cent. This increased steadiness of load is obtained at the sacrifice of 9 per cent in voltage, the meter tested being worked at 200 volts drop on the coil, instead of 220 volts, the normal line voltage. According to the results reported, the automatic compensation in load afforded by the ballast is much closer if the voltage variation is of lower range. Thus, for a change from 220 to 226.6 or to 213.4, i. e., 3 per cent above or below, the variation in the coil power will be kept to about ½ per cent above or below.

It is open to discussion whether a compensated load is desirable, or whether the convenience secured in testing meters by employing a compensated load is sufficient to call for the use of ballast glow-tubes. In most cases the variations of pressure occurring on the mains are not sufficiently rapid or great to introduce much difficulty in determining the mean pressure of supply during a test. Again, the ballast glow-tubes must be more sensitive to overload than the ordinary uncompensated alloy load coil, or rheostat. If not safeguarded, they are liable to be melted, since they run red-hot at working current strengths. The only conditions that ordinarily give rise to serious fluctuation of main pressures are where a long main runs radially out from the district supplied by the central station, and is only fed at one end, while electric elevators are connected to it, thus rapidly throwing heavy loads on and off. Whatever opinion may be entertained concerning the practical need for a compensated kilowatt, there can be no doubt that occasions must occur in which such compensated loads are both useful and convenient. The apparatus provides in a certain sense a new standard for the convenience of the electrical engineer, namely, a standard kilowatt with automatic compensation. A standard cell provides a portable volt, a standard wire provides a portable ohm, and the ballast-compensated wire provides a portable kilowatt, when connected to mains of normal assigned voltage, undergoing the ordinary range of variation. As to the construction of the apparatus, all that is needed is a sufficient number of ballast glow-tubes, such as are used in Nernst lamps, freely supported in such a manner as to dissipate their heat readily, and also so as to withstand shipment without danger of being fractured. These are simply connected to and with the ordinary tester's load coil.

The Institute Election.

The nomination blanks for the presidency of the American Institute of Electrical Engineers, for 1906-7, and for other offices, have just been sent out to the members of the Institute. The constituency appealed to has a voting strength of over 3,100. Several candidates are suggested or are already in the field. They include Dr. S. Sheldon, the efficient chairman of the committee on papers; E. W. Rice, Jr., third vice-president of the General Electric Company, an engineer and an inventor of distinction; Mr. John J. Carty, chief engineer of the New York Telephone Company, who has served the Institute with signal loyalty and success in various capacities; Dr. F. A. C. Perrine, long actively connected with Institute affairs, and well known as a consulting engineer; and Mr. Ralph Mershon, former chairman of the Institute Transmission Committee. This affords an excellent range of choice, and may result in a considerable splitting of the vote. Indeed, it is understood that some attempts have been made, but fruitlessly, to concentrate on some of these candidates and their supporters, or to substitute a candidate upon whom all could unite.

Underwriters' National Electric Association.

The first conference meeting of the Underwriters' National Electric Association will be held in March, 1907. Heretofore the meetings have been held in December, but at the request of Central Station men, who represented that it was very inconvenient for them to attend the meetings during the busy holiday season, the change to the month of March was decided upon. Following is the list of committees of the association appointed at the meeting in December:

Specifications for Electric Cranes.—A. L. Jacobs, chairman, 31 Milk Street, Boston, Mass.; J. G. Emery, Jr., Shaw Electric Crane Company, Muskegon, Mich.; A. G. Wilbor, 95 Pearl Street, Hartford, Conn.

Outlet Boxes.—E. N. Davis, chairman, Brookline, Mass.; E. McCleary, 213 Jefferson Avenue, Detroit, Mich.; Alfred Stone, 49 Westminster Street, Providence, R. I.; E. A. Fitzgerald, Syracuse, N. Y.; W. S. Boyd, 382 Ohio Street, Chicago, Ill.

Specifications for Metal Mouldings.—A. M. Paddon, chairman, 382 Ohio Street, Chicago, Ill.; J. E. Cole, 11 Wareham Street, Boston, Mass.; Wm. McDevitt, 151 South Fourth Street, Philadelphia, Pa.

Rheostat Rules and Specifications.—Geo. E. Bruen, chairman, 32 Nassau Street, New York City; J. C. Forsyth, 32 Nassau Street, New York City; George E. Fisher, 55 Kilby Street, Boston, Mass.

Wiring and Construction of Fan Motors.—George E. Bruen, chairman, 32 Nassau Street, New York City; J. C. Forsyth, 32 Nassau Street, New York City; W. H. Merrill, Jr., 382 Ohio Street, Chicago, Ill.

High-Tension Motors.—A. M. Schoen, chairman, 339 Equitable Building, Atlanta, Ga.; H. O. Lacount, 31 Milk Street, Boston, Mass.; Ralph Sweetland, 55 Kilby Street, Boston, Mass.

Electric Railway Wiring and Equipment.—Ralph Sweetland, chairman, 55 Kilby Street, Boston, Mass.; Wm. McDevitt, 131 South Fourth Street, Philadelphia, Pa.; B. E. Loomis, 19 Liberty Street, New York City; Frank T. Sloane, 85 Clinton Street, Brooklyn, N. Y.; O. B. Johnston, 55 Kilby Street, Boston, Mass.

Double and Single-Pole Switches.—Ralph Sweetland, chairman, 55 Kilby Street, Boston, Mass.; A. L. Jacobs, 35 Milk Street, Boston, Mass.; R. J. Daly, 245 Fourth Avenue, Pittsburg, Pa.

Construction and Wiring of Electric Signs.—W. H. Merrill, Jr., chairman, 382 Ohio Street, Chicago, Ill.; J. R. Strong, 35 South William Street, New York City; H. S. Wynkoop, room 33A, Municipal Building, Brooklyn, N. Y.

Series Lamps.—W. H. Merrill, Jr., 382 Ohio Street, Chicago, Ill.; F. W. Wilcox, manager, General Electric Company, Harrison, N. J.; A. M. Schoen, 339 Equitable Building, Atlanta, Ga.

Ground Connections.—C. M. Goddard, chairman. 55 Kilby Street, Boston, Mass.; F. E. Cabot, 55 Kilby Street, Boston, Mass.; E. V. French, 31 Milk Street, Boston, Mass.

Committee on Switches and Cut-outs.—H. O. Lacount, chairman, 31 Milk Street, Boston, Mass.; W. H. Merrill, Jr., 382 Ohio Street, Chicago, Ill.; J. E. Cole, 11 Wareham Street, Boston, Mass.; E. V. French, 31 Milk Street, Boston, Mass.; Ralph Sweetland, 55 Kilby Street, Boston, Mass.

Variable-Speed Motors.—H. O. Lacount, chairman, 31 Milk Street, Boston, Mass.; C. E. Skinner, Westinghouse Electric & Manufacturing Company; H. C. Wirt, General Electric Company.

Signaling Systems (*Rule* 64).—F. E. Cabot, chairman, 55 Kilby Street, Boston, Mass.; Ralph Sweetland, 55 Kilby Street, Boston, Mass.; E. A. Fitzgerald, Syracuse, N. Y.; C. H. Hill, 316 Walnut Street, Philadelphia, Pa.; C. J. H. Woodbury, 125 Milk Street, Boston, Mass.; F. W. Jones, 253 Broadway, New York City; C. C. Johnson, 44 East Twenty-third Street, New York City.

Theatre Wiring.—J. E. Cole, chairman, 11 Wareham Street, Boston, Mass.; H. C. Harris, Ohio Inspection Bureau, Columbus, Ohio; W. D. Carroll, city electrician, Chicago, Ill.

The Great International Power at Niagara.

From time to time note has been made in these pages of the attempts to regulate and restrict the electrical development on both sides of the Niagara Falls. Several measures are now pending in Canada, at Albany and in Washington, and the New York *Times* summarizes the situation in the admirable review quoted below: "It is not likely that the State of New York will adopt the recommendation of President Roosevelt to confer upon the United States the ownership of its park reservation at Niagara. This would, of course, simplify the problem of effective joint action with the Canadian Government toward preserving Niagara Falls from the spoilers planted on both sides of the river. Nor, we may safely say, will the present Legislature view with favor Gov. Higgins's suggestion further to limit the amount of water to be taken from the American side, and to repeal all dormant charters from the statute books, although the Governor may certainly be counted on to veto any bill that may be jammed through granting the electric companies more power. Meanwhile the Merchants' Association of New York, in conjunction with the American Civic Association, has been agitating the question of Federal protection of Niagara Falls by a treaty stipulation with Canada.

"Concurring opinions have been obtained by the Merchants' Association from former Attorney-Generals Griggs and Knox and from Attorney-General Moody, which leave no doubt that under our present Federal boundary law, action to preserve the Falls may very properly originate with the President. Gov. Griggs points out that the jurisdiction of the State is subordinate to the power of the National Government in two respects: 1. With respect to navigation, as to which the laws of Congress are supreme. 2. As to the subject of boundary between this nation and Canada, in respect to which the United States and Great Britain have the right, by treaty stipulation, to impose such conditions and regulations upon the use of the river and its waters as they deem mutually proper. Gov. Griggs further holds that 'A treaty duly negotiated between these two powers and ratified by the Senate of the United States would be the supreme law of the land, and if in such treaty it were provided that no such use of the waters as is contemplated should be hereafter made, and this regulation were enforced by act of Congress, the treaty and the legislation would be valid, the rights of the State of New York and all private riparian owners to the contrary notwithstanding.' Attorney-General Moody has counseled the President that international consideration and agreement on this point were desirable and necessary, and that he is 'fully authorized to invite concert of action with the British Government as representing the Dominion of Canada.' Senator Knox's opinion coincides with that of the Attorney-General.

"The power plants do not threaten the navigability of the river. On the American side the companies are authorized to divert into their chutes from the crest of the cataract a maximum total

of 48,400 cu. ft. of water a second, whence, having lent its force to the generation of electricity, it is poured into the rapids below. At present about 20,000 cu. ft. a second are actually used. Franchises held on the Canadian side in the Queen Victoria National Falls Park allow a total of 33,000 cu. ft. a second, and further developments have been planned which will require the use of 70,000 cu. ft. a second for power purposes. Above and below the falls the river remains navigable as before. The proposed treaty with Canada must, therefore, be aimed directly at the progressive spoliation of the falls by the power companies, on the ground that Niagara is a boundary river on the frontier of a foreign country upon which the United States has paramount jurisdiction in matters of the general welfare and of high public concern.

"Congress will probably enact the legislation necessary to this end. It is reported that nearly every member of that body has heard from constituents requesting that action be taken to protect Niagara. Senator Platt has introduced a joint resolution setting aside $20,000 for the expenses of a commission of four members to be appointed by the President, who are to meet similar commissioners from Great Britain to investigate and report on the matter, employing the necessary surveyors and clerks. The International Waterways Commission will probably investigate independently and report upon all questions of fact involved in the proposal. Such investigation would, of course, insure intelligent and proper regard for the separate rights vested by New York in its State Park Reservation; only the destructive use for commercial purposes of the great waterfall may justly be restricted by an international arrangement."

Automobile Testing Plant of Purdue University.

At a meeting of the Indiana Engineering Society, January 18, Prof. W. O. Teague read a paper describing the automobile testing plant recently installed at Purdue University under the direction of Prof. W. F. M. Goss. The plant forms a part of the engineering laboratory and is primarily intended for instructional purposes in the experimental engineering side of automobile work. The general design of the plant is similar to that of the locomotive testing plant at Purdue.

The power exerted by an automobile in moving itself on the road is the tractive pull of the machine times the distance passed over by the machine. In order to determine these two quantities it is necessary to support the automobile so that the draw bar pull and the revolutions of the driving wheels may be measured. For purposes of test the automobile must remain at rest and the power delivered at the driving wheels, which would ordinarily drive the machine forward, must be absorbed by some form of brake. According to the arrangement in the laboratory, the front wheels of the automobile are supported by a fixed platform. Two pulleys fixed to a common shaft free to revolve are provided to support the driving wheels of the automobile and a Prony friction brake is placed on this shaft to absorb the power delivered by the driving wheels of the automobile to the supporting wheels.

The Prony brake used consists of a cast-iron wheel with a wide flanged rim. Two iron straps fitted with strips of wood forming the friction band extend around the pulley rim and this may be tightened or loosened by means of a screw clamp, thus increasing or decreasing the friction on the pulley rim. The pulley is prevented from heating by running water into the flanged rim where it takes up heat from the rim and is evaporated. With the machine mounted in this manner the draw bar pull is measured by a spring balance attached to the driving axle of the automobile by means of the draw bar and to the frame of the testing machine.

The draw bar is fitted with a dash-pot to reduce vibration. The machine is kept centered over the supporting pulleys by means of a hand wheel. A pointer on the side of the frame and attached to the driving axle of the automobile guides the operator in keeping the automobile in its proper position. The space passed over by the automobile is obtained by counting the revolutions of the supporting pulleys by means of a revolution counter and since the pulleys are of a fixed diameter the distance traversed will equal the space passed over by a point on the rim of the pulley. From this can readily be derived the speed of the automobile in miles per hour.

A motor-driven pressure blower placed below the platform and fitted with the necessary piping and discharge hood supplies air to cool the circulating water in the radiator of the automobile. A motor-driven exhauster takes air from a point at the end of the fixed platform and the exhaust gases from the automobile are led into its suction pipe and are thus discharged from the testing room.

The testing apparatus is located in a room which is provided with large doors to permit automobiles being placed on the testing platform. The machines are hauled upon the platform by means of a block and tackle, two movable runs being placed at the end of the platform for the wheels to roll upon. Safety stops made of wood are placed in front of and behind the front wheels to prevent movement of the machine in case it should release itself from the draw bar at the rear. These blocks are placed in position after the machine has been mounted upon the supporting wheels.

The Erie Railroad Electrical Commission.

The Erie Railroad has been studying for some time past the possibilities of electric traction for its suburban service in the neighborhood of New York City, but the equipment of these lines has been delayed for a number of reasons, among them the construction of an open cut in place of the present Jersey City tunnel and the rearrangement of the terminal station at Jersey City. Nevertheless, the directors of the company have recently authorized vice-president Graham to organize an electrical commission to study the subject in detail, and it is thought that one of the branch lines, either the Northern Railroad of New Jersey or the Greenwood Lake Division, will be equipped with electricity within the next year. The electrical commission which was appointed Feb. 2 consists of the following: J. M. Graham, vice-president, chairman; Bion J. Arnold, L. B. Stillwell, E. A. Williams, general mechanical superintendent; A. J. Stone, assistant general manager; C. H. Morrison, acting electrical engineer and secretary of the commission.

The commission will make a study of the proper system to be adopted and will report to the directors at an early date.

Worcester Polytechnic Institute Electrical Engineering Laboratory.

One of the finest engineering laboratories in this country will shortly be erected by the Worcester, Mass., Polytechnic Institute for its Electrical Engineering Department, the plans for which have been prepared by the Electrical Engineering Department. Prof. French, of the Civil Engineering Department, will have superintendence of the erection of the building, the architects for which are Messrs. Peabody & Stearns, of Boston. The building will be about 115 by 200 ft., three stories in height and enclosing three sides of a court 50 by 100 ft. The main laboratory room will be spanned by a 10-ton crane with two galleries on one side and one on the other the entire length of 200 ft. Among the features are a laboratory for the study of high-potential phenomena and high-potential power transmission, and an electric railway engineering laboratory on a larger scale than has heretofore been attempted. There will be a lecture room fully equipped for experimental demonstration instruction; a standards laboratory; designing room; photometric laboratory; a general electrical laboratory, and a department reading room and library.

Prof. Harold B. Smith is director of the Department of Electrical Engineering. Prof. Smith's staff consists of Prof. Joseph O. Phelon, assistant professor of electrical engineering; Prof. Albert S. Richey, assistant professor of electric railway engi-

neering; Messrs. Harry C. Walter and Carl D. Knight, instructors in electrical engineering, and Francis J. Adams and Ernest C. Morse, assistants in electrical engineering.

Construction and Electrical Equipment of the New York Central Tunnel Under the Detroit River

Bids for the construction of a double-track tunnel under the Detroit River to connect Windsor, Ont., with Detroit, Mich., have been requested by the New York Central Railroad and will be opened March 8. The tunnel will be operated by electricity and bids for the electrical equipment will be called for about February 15. The advisory board of engineers which has charge of the engineering and award of contracts consists of W. J. Wilgus, vice-president, chairman; H. A. Carson, of Boston, and W. S. Kinnear, of Detroit. The tunnel will have a length, including approaches, of 12,800 ft., the length of the terminal proper being 7,860 ft. The grade in the tunnel on the Detroit side will be 2 per cent and on the Windsor side 1½ per cent.

Central Station Advertising.

In connection with the twenty-ninth convention of the National Electric Light Association to be held at Atlantic City, June 5, 6, 7 and 8 next, it is proposed to repeat on a more extensive scale the exhibit of central station advertising that was given so successfully last Spring at Denver, and which, together with the extended discussion to which it gave rise, did much to awaken the present interest in the subject of central station business getting. Steps are now being taken to carry out this purpose, and it is believed that the exhibit will prove attractive and instructive to central station managers. It is proposed to divide the exhibit into two sections, one showing the work done by the larger companies which maintain their own force for such work, and issue and prepare their own bulletins; and the other comprising bulletins and material furnished by the new concerns that have sprung up lately to supply the smaller stations with this class of matter, many of which have already done very effective work. In addition to this a display will be made of posters, large newspaper advertising and many original drawings and sketches employed in bulletins.

Public Lighting in New York City.

In expectation of a largely increased business in connection with the lighting of the city's streets, schools and other public buildings, the New York Edison Company last week, in submitting its bids for the eleven months ending February 1, 1906, tendered a yearly rate as low as $80 per arc lamp. At the present time there are in the boroughs of Manhattan and the Bronx something less than 5,000 lamps, as compared with 10,297 in Philadelphia, with that city's population only 1,023,000, and 3,090 lamps in the Metropolitan district of Boston, where the population is about 200,000.

Under the law which was passed by the New York Legislature, and which went into effect on July 1, 1905, the New York Edison Company is authorized to charge $100 for each standard arc lamp of 450 watts, and $130 a year for two lamps per post, such as seen in Fifth Avenue, and 10 cents a kilowatt-hour for incandescent lighting and power in the public buildings. The New York Edison Company now agrees to charge the city $100, or the legal rate, for 5,000 lamps; the price of each lamp in excess of 5,000 is $95 until the total number of lamps reaches 7,500, when the price of all the lamps becomes $95, including the original 5,000. When the number of lamps reaches 10,000 the price of all the lamps is reduced to $90; when 12,500 lamps are reached the price becomes $85, and when the number of lamps reaches 15,000 the price of all the lamps is reduced to $80 per lamp per year. This is a reduction of $20 per lamp below the present legal rate, as fixed by the Legislature.

Equally marked is the reduction that the New York Edison Company offers in connection with the lighting of the schools and other public buildings. The present legal rate for this service is 10 cents a kilowatt-hour, and a reduction of 25 per cent is now made under the new bid, reducing the city's price to 7½ cents a kilowatt-hour. This price includes incandescent lamps, the supply of carbons and the trimming of arc lamps. The price for power service in the public buildings, under the New York Edison Company's new bid is reduced from 10 cents to 6 cents a kilowatt-hour—a very material reduction.

Governor of New York Discusses Public Utility Question.

In a recent message to the Legislature, Governor Higgins gave some views on the subject of high rates for public service. He said:

"Private companies control our railroads, telegraphs, telephones, gas and water supplies and other services which have become necessary to the daily lives of many of our citizens. Such companies are quasi-government agencies, vested with the sovereign power to condemn private property for their uses. They are permitted to exist because the State delegates to them its own functions for convenience and economy and to promote industrial development. Such corporations should be tolerated only so long as their rates are reasonable and their service prompt and efficient.

"It has been suggested by a learned justice of the Supreme Court of the United States that such companies have not even the constitutional right to a profit on their investments and that, while they cannot be required to do business at a loss, they may be compelled to content themselves with a return equal to the cost of operation and maintenance. So radical a theory has not been adopted, but that it should be declared from the bench of our most eminent and conservative tribunal is a significant suggestion of the power of the people to regulate public service companies, or failing therein, to exercise their functions directly through government—State or local."

This statement is interesting in connection with the recent decision of the Supreme Court whereby the Hudson River Company was compelled in one instance to maintain the lower rate granted by a company which afterward became a sub-licensee.

A Central Station Interruption.

An item was given publicity a week or two ago to the effect that the supply of current had been interrupted at the Kennett sub-station of the Northern California Power Company. Mr. W. W. Wheeler, engineer of the company, at Redding, Cal., in an interesting letter states that there was virtually no foundation for the story, and he furnished us the subjoined details: "The facts were, as near as we can learn, that a transformer on our 2,000-volt distribution blew its fuse and put a portion of the town in darkness. This fuse was replaced within ten minutes, but in the meantime a reporter for a local paper rushed to a telephone and telephoned to a Redding paper that the power was off at the smelter and that the same was rapidly 'freezing up.' This in turn was telegraphed to San Francisco. A correction was sent in a few hours later, but did not overtake the original article. Now, as we have two power lines entering Kennet from opposite directions and from two independent power houses, there is small chance for a shut down in that neighborhood. Further, we have the record of having supplied the Mountain Copper Company Smelter at Keswick from a single pole line carrying two circuits and fed from one of the two power houses above mentioned. This double circuit line is thirty-five miles long, operates at 26,000 volts, and was delivering 1,500 and 1,600 kw for a period of three and a half years, with a total shut down during that period of eight hours and thirty minutes, five hours of that being a voluntary shut down and occurring on two Fourths of July."

Organization of the Central Station Business Department.

Owing to lack of space, the conclusion of the discussion at the recent Chicago meeting of the Northwestern Electrical Association on Central Station business-getting methods was omitted from the issue of last week and is now given below.

Mr. J. R. Cravath said he heartily agreed with the remarks of Mr. Almert that the great majority of central station companies are not yet awake to the importance of the new business department. The gentlemen assembled at the convention represented the more progressive element, not the average. He could not help noticing as he visited a large number of plants in the course of the year, the great difference in the development of the business in different towns. He wished to emphasize one point made in the discussion, that it is not always low rates that count in the getting of new business. He had in mind a town in central Illinois where power had been selling for some time at five cents per kw-hour, and yet it is one of the poorest towns for power load that he knew of, not because the business was not there, but because the company had not got the business. That was only an isolated case, but there were plenty more like it. He thought there were more opportunities for great development in the central station business than most of us have any idea of at the present time.

Mr. Utley, of Watertown, Wis., said he thought it better to pay solicitors a commission on the increase of business rather than on the sale of appliances, since it was increase of load and not new appliances that the company wished to get on its lines. Another plan that helped his company was to sell gas fixtures to any one wishing them, allowing them whatever gas they used the first year free. The profit made on the fixtures was sufficient to cover the loss for the first year on the gas consumption.

Electric Power for the Rand.

In a recent interview in London Mr. Robert Hammond gave further details concerning the plans for the steam generation of electric power for the Rand, which scheme has previously been noted in these columns.

Mr. Hammond said that all the money necessary for the preliminary expenses has been subscribed and some leading financiers have expressed their willingness to find the bulk of the capital for the entire undertaking as soon as it is required. An agent is now on the ground looking after the matter of coal contracts, the choice of site and right of way. A bill now before Parliament includes the right to supply electrical energy throughout the Transvaal Colony.

The plan is to lay down works at Vereeniging on the line of railway from Johannesburg to Bloemfontein, and situated on the Vaal River where a dam insures an ample supply of water for condensation purposes. The site is rendered the more desirable from the fact that it is the center of a coal district, in which coal of very fair quality is mined. The electric current will be conveyed at high tension to a central point for distribution over a radius of 25 miles to all the mines. It is estimated that electrical energy can be delivered to the mines and converted to any pressure at a cost a trifle under 1.4 cents per kw-hour, the calculation being based upon the very large consumption of 300,000,000 kw-hours per annum, which, however, is the estimated requirements of the mines. While the mines would be the principal consumers, current would be available for general use, as, for example, to supply the contemplated railway between Johannesburg and Pretoria.

The plan provides for seven steam generating sets, each of a capacity of 10,000 kw., and each set being capable of sustaining an emergency overload of 20 per cent. On the assumption that one set would be occasionally laid off for overhaul, there would always be available for active use six sets with a total normal capacity of 60,000 kw and an overload capacity of 72,000 kw, thus being amply sufficient to meet the estimated present requirements and the estimated output of 300,000 kw-hours per annum. The total cost of the power-house and plant is calculated to absorb nearly one-half of the entire capital outlay, which would be about $10,000,000.

Provision is made for a storage reservoir containing 100,000,000 gal. of water, which would be drawn upon for the condensation water, and be pumped from one spot and returned to the reservoir at the most distant point from the intake. In preparing the estimate of the costs of working, it is presumed that a matter of 470,000,000 gal. of water per annum for making up the losses by evaporation will be available at a cost of 87 cents per thousand gallons. By the selection of Vereeniging, however, as the generating site the outlay of $1,500,000 on the storage tank would be avoided, presuming that favorable arrangements are made for the use of the Vaal River. On the other hand, $400,000 must be set down as the cost of the weir dam to provide a reservoir as a stand-by in times of drought, and for the laying down of the necessary line of inlet and return pipes.

Development of New York Subway Travel.

There seems every prospect that the recent traction merger in New York City will be followed by a rapid development of new electric subways. Members of the Rapid Transit Commission have been told by representatives of the allied traction interests that the engineers of the Interborough-Metropolitan have decided that the subway traffic has become so heavy that the present trunk line from the Battery to Grand Central Station will be unable adequately to handle the traffic of the proposed Lexington Avenue line by the time such a line can be completed.

The complete Lexington Avenue line was laid out by the commission at the request of the Metropolitan interests when they were fighting the Interborough for control of the subway situation and runs south to Thirty-fifth Street with the lines then running west through Thirty-fifth and Thirty-sixth Streets, south through Broadway, Fifth Avenue and connecting streets to the Battery. The Metropolitan Company intended to make a hard fight for this line to compete with the present subway. The Interborough Company merely intended to bid on the section north of Forty-second Street to connect with the present line at Grand Central Station. Now they are understood to be willing to construct the entire line, and the Seventh and Eighth Avenue lines in addition.

Assurances have been given to the Rapid Transit Board that the Interborough-Metropolitan people are willing to construct these lines as well as the crosstown lines connecting with the new Pennsylvania Railroad Station, with their own money if they can obtain profitable rental terms. A bid on such a basis will, it is said, be welcomed by the board. Meantime there are hours when the liberal resources of the existing subway system are sorely taxed by the pressure upon them of travel developed so suddenly and so enormously.

Production of Aluminum in Europe.

The output of aluminum by the Pittsburg Reduction Company in Canada and the United States is placed at 4,200 tons. The high price of copper has recently developed new interest in the production of the metal, whose price has risen in spite of the growing quantity available, and which has come into large demand in the electrical field. United States Consul Guenther, of Frankfort, sends the following German report on the European situation:

"The companies at present producing aluminum are: 1. Aluminum Industry A. G., in Neuhausen, Switzerland, which also has works at Lend-Gastein, Austria, and at Rheinfelden, Baden. The total annual production of the three works of this company was estimated at 3,675 tons (at 2,204 metric pounds), employing 88 bureau officials and 661 workmen. It paid last year on its stock an 18 per cent dividend, and recently raised its share capital from 16 to 26 million francs. The new shares were taken by a bankers' syndicate at 250 per cent. The Neuhausen com-

pany secured territory in the Swiss Canton of Wallis, where it has the use of 50,000 hp of water power. New works are to be erected there. It has also purchased the stock of and now owns the chemical works of H. Bergins & Co., in Deutsch Lissa, Silesia, where about 200 workmen are employed, mainly in making salts of aluminum.

"2. British Aluminum Company, at Feyer, Scotland, which has also works in Sarpsfos, Norway; its total production per year has been estimated at 2,250 tons.

"3. Société Électro-métallurgique Française, a French company, with works at La Praz and Les Sordrettes, in Savoy, produces about 2,325 tons of aluminum per year.

"4. Société des produits chimiques d'Alois et de la Camargne has works at Calypse and at St. Felix, in Savoy, whose combined annual production is stated to be 2,100 tons. The French aluminum works were closed for some months owing to a strike."

The Old Western Union-Bell Telephone Contract.

Advices from Boston state that the long-drawn-out case of the Western Union Telegraph Company vs. American Telephone & Telegraph Company for an accounting involving from $2,000,000 to $4,000,000 has been before Everett W. Burdett as master for two years, and in that time only one side of the case has been heard—namely, the evidence of the Western Union. The Western Union Company completed its evidence a month ago, and it is expected that the American Telephone & Telegraph Company will at once proceed to present its evidence, in which event a report to the court may be made this summer.

The present case has been in the court in one form or another for twenty-two years, and if appeal is taken to the Supreme Court of the United States, it will be some time before a conclusive decision is reached. The Western Union Company seeks an accounting for certain shares of stock in the companies licensed by the old Bell Telephone Company under a contract entered into in November, 1879. The defendant was then known as the National Telephone Company.

Under this contract the Western Union Telegraph Company was to go out of the telephone business and turn over all its telephone property and exchanges to the Bell Company, the latter agreeing not to interfere with the telegraph business. The Bell Company in consideration was to pay the Western Union upon all telephones used in the United States under license from the Bell Company a royalty, or bonus, of 20 per cent for the term of 17 years. After the contract was made, however, the Bell Company began to give exclusive licenses to sub-companies in various parts of the United States, in consideration of which the companies gave the Bell Company a certain percentage, generally 35 per cent, of their stock, as a payment for the license. It is in respect to this latter mode of procedure that the Western Union is securing an accounting.

CURRENT NEWS AND NOTES.

CENTRAL STATION PRIZES TO SCHOOL CHILDREN.—The Janesville (Wis.) Electric Company has offered prizes aggregating $17.50 to the pupils of the Janesville high school, to be awarded for the three best papers on the subject, "Electricity in the Household."

BANQUET COOKED BY ELECTRICITY.—The biggest dinner ever cooked by electricity was served January 31 by the Ontario Power Company, which had for its guests the members of the Canadian Society of Civil Engineers, the commissioners of the Queen Victoria Niagara Falls Park, and a number of others. Covers were laid for 225. The Ontario Power Company has recently installed a very large electric kitchen for its own use, which absorbs about 40 hp. A meal for 300 can be prepared with ease.

CHICAGO MUNICIPAL TROLLEYS.—A cable dispatch from Chicago of February 3 says: "Mayor Dunne and his advisers have planned a temporary trolley system for the downtown parts of the cable lines. The city will pay for the work if constructed by the companies, the latter paying the city rent for the use of the system. Within one year the city is to acquire ownership of the equipment. W. W. Gurley, chief counsel of the Union Traction Company, is in New York to lay the plan before the controlling interest in the company."

BREAKING OF PORTO RICO CABLE.—Cable communication with Porto Rico and all islands east of the American dependency was suddenly cut off a few days ago by the breaking of the two cables in use by the West India & Panama Cable Company. Whether the break was caused by a volcanic disturbance is not as yet known. Islands now out of telegraphic touch with the world are St. Thomas, Santa Cruz, Antigua, St. Kitts, Montserrat, Nevis, Dominica, St. Lucia, Barbados, St. Vincent, Martinique, Grenada, Tobago and Trinidad. Porto Rico has communication by wireless telegraphy.

THE ILLUMINATING ENGINEERING SOCIETY will hold its regular monthly meeting on Tuesday evening, February 13, at the Hotel Astor, New York City. The programme of the evening consists in an inaugural address by the president, Mr. L. B. Marks, which will outline the general scope and policy of the society, and a discussion of the topics by those present. Tables will be reserved in the grill room as before for those who wish to dine at the hotel on the evening of the meeting. These dinners are entirely informal, and it is hoped that as many as possible will be present to add the social feature to the technical.

CANADIAN NIAGARA FALLS.—Before the Canadian government can enter into a proposed agreement with the United States government with respect to the preservation of Niagara Falls, it will be necessary for it to take over the jurisdiction of the Falls at present held by the Province of Ontario, and the Canadian electric companies are stated to favor such action, for the reason that if the jurisdiction remains as at present, there is danger that the Ontario government may endeavor to take the matter of Niagara power development out of the hands of the individual companies and enter into the business itself. It is also reported that the power companies on the American side of the Falls are, for similar reasons, anxious to have the Federal government take over the control of the American Falls from New York State, and that these companies are exerting influence to this end at Washington.

REVERSE-CURRENT CIRCUIT-BREAKER.—A difficulty which has been encountered in the use of reverse-current circuit-breakers resides in the fact that the potential across the terminals of the apparatus may fall to a value insufficient to furnish the potential coil of the cut-out with the proper amount of current for operation. A patent issued January 30, 1906, to Mr. Leonard Wilson, describes a method by which this difficulty may be overcome. A commutator is driven synchronously and in phase with the electromotive force of the machine. This commutator serves to rectify the current obtained from the secondary of a series transformer connected in the supply leads of the generator. The rectified current is passed through the movable coil of an electrodynamometer which is provided with field magnetism of constant strength. According to the phase position of the current in the series transformer at the time when it is rectified, the movable member of the electrodynamometer will tend to be deflected in the one or the other direction. When it moves in a direction determined by the reversal of flow of energy from the generator, it closes a circuit from a battery through a tripping coil of a switch arranged to open the circuit of the generator. The circuit-breaker is readily adjustable for changes in operating conditions by shifting the brushes on the commutator.

TANTALITE PENS.—We note that Siemens & Halske, who have done so much to develop the tantalum lamp, have taken out German letters patent for a new writing pen made of tantalite. It is expected to supercede or compete with steel and gold nibs.

THE ELECTRICAL SALESMEN'S ASSOCIATION.—Mr. George H. Erich, secretary of the Electrical Salesmen's Association, has established permanent headquarters at 401 Monadnock Block, Chicago. The constitution and by-laws of this association which held its first convention in Chicago January 20, have been printed in booklet form and can be obtained by those interested.

THE IOWA CONVENTIONS.—The Iowa Electrical Association will hold its annual convention this year at Des Moines, Iowa, April 18 and 19. The Iowa Street & Interurban Railway Association will have its convention April 19 and 20, so that managers interested in both properties can attend both conventions. The headquarters of the Street & Interurban Railway Association will be at the Kirkwood Hotel.

APPARATUS IN ARGENTINA.—Government statistics from the Argentine Republic show that of incandescent lamps imported in the period 1900-4 the American percentage was 40.2, although in the period 1896-8 it was 42.3. The importation of electric light carbons was a percentage of 33; arc lamps, 12.5. This business would seem susceptible of increase, and in many other branches the growth of American importations into the Republic is notable.

WATER POWER DEVELOPMENT DAMAGE.—An interesting question has been raised in a United States Court in a suit for damages caused by a dam in one state flooding lands in an adjoining state. The Berkshire Power Company has a dam across the Housatonic at North Canaan in Connecticut, and it is alleged that because of the high water thus caused meadow lands owned by the complainants in Massachusetts have been flooded, pasturage ruined, property damaged and the health of the complainants' families endangered. Compensation is asked for the damage and also an injunction to restrain the company from maintaining the dam.

BAVARIAN POWER.—The Munich municipality has under consideration a proposition for the generation of electric power, to be distributed throughout Bavaria, at a cost of $5,000,000. It is proposed to dam up the River Tear near Wallgorn, and form a huge lake, which will be connected to the Walchen and Kochel Lakes by tunnels. From the immense supply of water thus obtained, estimated at a hydro-electric capacity of 96,000 hp, it is thought that sufficient electricity could be obtained to work the railways and factories. The initial expenses of the work would be about $3,750,000, which is the sum Bavaria now spends abroad every year for coal used on the government railways.

THE LIGHTS OF BOGOTA.—United States Consul Snyder, of Bogota, United States of Columbia, does not speak very enthusiastically of the local lighting. Being consulted as to the introduction of acetylene, he said: "Owing to prevailing conditions here, and as a result of my personal observations, I am inclined to believe that such systems, properly introduced, would ultimately become very popular. Bogota, for its size and apparent importance, is one of the worst-lighted places I have ever been in. There is no public service at all. But one local electric light company exists, and the high prices charged for its service put it beyond the reach of the great mass of the people, who, together with those in the surrounding villages, have to depend for lighting purposes on oil lamps, generally of a very poor quality, and wax candles. Some time ago I induced a large dry goods merchant here to send to the States for a trial order of acetylene burners, but shortly after their arrival he had to leave for England, so nothing came from it; and I very much doubt if he could have given it the attention necessary, in connection with his other business, for its successful introduction." There ought to be very good and cheap water power available around Bogota.

PUBLIC SERVICE FRANCHISES.—The People's Institute, of New York City, is planning to conduct in the latter part of February a series of public conferences on municipal ownership and operation of public franchises. The dates and titles are: February 20, "Municipal Ownership and Operation in Europe"; February 22, "Municipal Ownership and Operation in America"; February 23, "Public Ownership and the Spoils System."

A GREAT GROWTH.—In its excellent Bulletin for February, the New York Edison Company reports the figures of its new business taken on during 1905. The company secured 19,860 separate contracts for electrical service. Of incandescent lamps there were 992,782; of arc lamps 6,870 and of motors 37,719 horsepower. Some additional apparatus of a miscellaneous character brought the ttoal up to 1,657,408, equivalent of 16-cp lamps of 50 watts each. Such a rate of growth applied to the whole country would make the present national statistics of electric light and power sink into insignificance.

TERRITORIAL RIGHTS OF NIAGARA, LOCKPORT AND ONTARIO POWER COMPANY.—The rights of the Niagara, Lockport & Ontario Power Company to operate beyond the limits of the Counties of Erie, Orleans and Niagara was the subject of recent court proceedings. The matter came up in connection with the proceedings for the condemnation of certain property in Genesee County for the uses of the Power Company. Judge Truman White decided that the preliminary objections were not well taken and the issues raised were referred to a referee to hear, try and determine.

OUR FOREIGN COMMERCE.—It is brought out in the Government figures that the foreign commerce of the United States approaches surprisingly near to the three-billion-dollar point in the calendar year 1905. The total imports and exports of merchandise, as shown by the Department of Commerce through its Bureau of Statistics, is 2,806 million dollars, against 2,307 millions in 1900, an average increase of 100 millions a year in the five-year period. If to the 2,806 millions of foreign commerce in 1905 were added the figures of trade with Hawaii and Porto Rico, formerly foreign territory and included in the statements of foreign trade prior to 1901, the total would approximate 2,900 million dollars, or about 600 millions more than five years ago, and 1,200 millions more than ten years ago. The growth in exports during the year was 175 million dollars and in imports 143 millions.

BIDWELL AGAIN.—Benson Bidwell has bobbed up again, this time as the inventor of a "cold motor." In a half-page advertisement in daily papers offering stock for sale at 40 cents per share, the statement is made "I have made millions of dollars for thousands of people by my patents. I have never made an unsuccessful invention." This is followed by the claim that Bidwell invented the electric fan, the electric trolley car system and the "water electric generator." As illustrated, the "cold motor" has the appearance of an enclosed electric motor; a small pipe leads from one end of the shaft to a cylinder with a valve, and a similar pipe from the other end of the shaft to a cylinder with a valve and a pressure gauge. The resemblance to an electric motor is increased by two electric wires entering the casing. It is stated that this device "is guaranteed not to burn out and is exactly the kind of a motor the steam railroad people have been looking for. It will change all the steam railroad systems over to electric roads, because it will be cheaper to run than steam, and can be run faster and more safely than any present method. By using the Bidwell cold motor a train of cars could be run from New York to San Francisco without a stop at the rate of 60 or 80 miles an hour and not even warm up and without a hitch. Besides running faster they would be more safe and sure than steam, cost less to operate and would last longer than any other motor now known. The Bidwell cold motor is the greatest invention out since I invented the trolley car." Investors are warned that they must come quick or not at all, as the stock is selling like hot cakes.

ST. PETERSBURG STREET RAILWAYS.—A cable dispatch from St. Petersburg of February 3 says: "Another section of the contract for the electrification of the street car system of St. Petersburg was awarded to-day to the American Westinghouse Company. It involves the expenditure of $1,675,000. The power will be generated at Imatra Falls, Finland, and will be transmitted 120 miles."

COST OF TROLLEY DEVELOPMENT.—Last week members of the Brooklyn League, escorted by officials of the Brooklyn Rapid Transit Company, made a tour of inspection over the company's lines. President Winter, of the company, informed the League members that the company had expended about $20,000,000 for improvements since he took office, in July, 1902, and that other work costing $12,000,000 was now under way. Of the sum expended, he said, $8,653,000 had gone for car equipment. The other improvements included new elevated shops and stations, elevating and depressing tracks, new Williamsburg power station, car storage depots and track construction.

UNDERGROUND FOR BUFFALO.—Another city for which an underground road is proposed is Buffalo. The Buffalo Subway Railroad Company has been incorporated with a capital of $1,000,000. It is the intention of the company to build a subway similar to the one in New York City. It is understood that Philadelphia capitalists have agreed to furnish all the money necessary to build the proposed road. The city officials are said to be in favor of the enterprise. The road is to extend from a point on Carolina Street, southwest of the lands of the New York Central & Hudson River Railroad Company, thence easterly beyond the easterly city line to a point about 2,000 ft. beyond the lands of the Terminal Railway of Buffalo in the town of Cheektowaga. A branch will run from the main line at William Street and Fillmore Avenue to the intersection of Curtiss and Lovejoy Streets.

CENTRAL STATION ADVERTISING.—In connection with the meeting of the National Electric Light Association at Atlantic City next June, it is proposed to repeat on a more extensive and complete plan the exhibit of central station advertising that was given with so much success last year at Denver for the first time. Steps are now being taken to carry out this purpose, and it is believed that the exhibit will prove attractive and instructive to central station managers. It is proposed to divide the exhibit into two sections, one showing the work done by the larger companies which maintain their own force for such work and issue and prepare their own bulletins, and the other bulletins and material furnished by the new concerns that have sprung up lately to supply the smaller stations with this class of service and many of which have already done very effective work. In addition to this, a display will be made of posters, large newspaper advertising and the original drawings and and sketches employed in the bulletins.

INDIANA LIGHTING ORDINANCES.—The last Indiana Legislature passed a law providing that a city or town may command by ordinance that steam and interurban railroads shall provide electric lights at street crossings to burn twenty minutes before and twenty minutes after the passage of trains. The town of Salem passed an ordinance and attempted to penalize the Monon railroad for its violation, and the case was appealed to the Supreme Court, where the judgment penalty was reversed. The court held the ordinance invalid for its failure to designate what kinds of light should be provided. The court said that neither the railroad company in obeying such an ordinance nor the courts in enforcing it can be required to know what kind and power of lights are used by a town at a particular time, and that the lighting ordinance must be specific and complete in itself, so that it can be known from the consideration of its terms and the acts of a defendant railroad, whether or not the ordinance has been violated.

MURGAS WIRELESS SYSTEM.—A special telegram of February 3 from Wilkesbarre, Pa., says: "Father Joseph Murgass, of the Slavonic Catholic Church of this city, who has invented a system of aerial wireless telegraphy, announced to-day that experiments in underground wireless telegraphy have reached a stage when he can promise soon to send a wireless underground message to Europe. He will spend $20,000 on experiments. A shaft 3,000 ft. deep will be sunk here and a similar one in Europe. Each will be concreted to guard it from dampness, and the wires running from the receiving and dispatching points will be encased in iron or steel tubing. His aerial wireless system, which replaces the Morse code with musical tones, each indicating a letter or a code word or group of words, will be employed. Father Murgas worked seventeen years to perfect his system now in use between this city and Scranton." The Murgas system has already been described in the Electrical World.

RECEPTION TO OSTWALD.—To mark their esteem and respect, a number of the chemists of America gave a reception to Prof. W. Ostwald, the distinguished German chemist, on the occasion of his return home this week. The reception occurred at the house of the Chemists' Club, New York City, on Friday, February 2, and was in the hands of the New York Section of the American Electrochemical Society. It was preceded by a banquet at the Hotel Savoy, given by a number of intimate personal friends. The reception was a crowded affair. The audience hall was profusely decorated with flags and evergreens, and a great many notabilities were present. The speakers were Dr. C. A. Doremus, presiding; Prof. J. W. Richards, on behalf of the American Electrochemical Society; Prof. C. F. Chandler, for the 4,000 chemists of America; and Prof. Morris Loeb, for the many old and recent students of Ostwald. Prof. Loeb, also presented a beautifully illuminated vellum album, containing portraits of a few Americans distinguished in electrical development and in chemistry, and containing the autographs of a great number of American admirers. Prof. Ostwald replied in admirable English, but regretting his poor command of the language recommended very warmly the study and adoption of such a universal medium as "Esperanto." The close of his charming speech was followed by enthusiastic applause. The members then commingled, and the steins clinked freely, with many a "hoch" and "prosit" and student song, until the night was far—and well-spent.

GERMAN TECHNICAL EDUCATION.—U. S. Consul Harris, of Mannheim, Germany, says that the German Empire is rapidly building up a class of men for whom it has no employment at fair wages, and for whom the demand does not increase as fast as the supply. The Consul writes: "The question of erecting a school for the building trades in Mannheim being at present under discussion, a prominent constructing engineer has contributed an article to a leading newspaper of the city in which he aims to show that technical education in Germany has gone beyond actual needs. He contrasts the number of those taking such training with the number in other professions, and concludes that the ranks of technically trained are at present much overcrowded. Statistics show that the increase in numbers in the technical ranks has gone far beyond the demand—200 per cent against about 50 per cent on the average. The consequence of this overproduction in technical resources is a constantly diminishing rate of wages, as the law of supply and demand applies here as elsewhere. Wage statistics, which were compiled from inquiries made of 20,000 members of the German Technical Association and which were presented in the Reichstag by Dr. Heinz Potthoff, a member, show the following picture: Almost one-fourth of all city and other trained appointees receive a salary under 1,800 marks ($428.40) per year, 35 per cent receive from 1,800 to 2,400 marks ($428.40 to $571.20), only 24 per cent receive from 2,400 to 3,000 marks ($571.20 to $714), and only 19 per cent receive over 3,000 marks ($715). It is to be noted that among those considered was a large number of office men who are engaged with public officials, which gives to the total a more favorable aspect, because among officials so employed a rate of salary from 2,100 marks ($499.80) to 2,700 marks ($642.60) generally prevails. From all this it appears that for an increase of technical resources and schools there is at present no pressing demand. There is an increased and, as it were, artificially created proletariat, and the various industries are not in a position to pay for these superfluous powers."

Generating Station for the Electric Railways in Belfast, Ireland.

THE municipality of Belfast has recently placed in operation a modern electric generating station for supplying power to the street railways, which had previously been run by means of horses. When it is known that this city has a population of almost half a million, and that street cars have been in use there for more than 30 years, the significance of the recent changes will be appreciated.

The station is designed to deliver power to a rolling equipment consisting of 170 single-truck, double-deck cars operating over the equivalent of 80 miles of track. Each car weighs complete about 10 tons, including electrical equipment, and will carry 22 passengers inside and 32 outside.

The building is situated on the bank of the River Lagan, which is navigable for barges, and will provide an unfailing supply of water for the steam condensers. Owing to the soft nature of the ground some 1,750 piles had to be driven through 30 ft. of river mud down to the rock. The foundations on top of the piles are formed with cement concrete in which is embedded a steel grill work made of old rails. The framework of the building is of steel and the roof and floors were completed before the brickwork was commenced, so that the coal bunkers, boilers and engines were installed while the building was being erected. This arrangement allowed the electric cars to be placed in service within the time allotted for the completion of the work, although the building is not yet completed.

The generating station (shown in Fig. 4) forms an extension of the electric lighting station, which was erected in 1898 and is likewise owned by the city. All of the equipment installed has been arranged for both lighting and traction supply. The new generators have, therefore, been provided with compound windings for tramway supply at 550 volts, and can supply lighting current at from 440 to 500 volts on the outers of the three-wire system. The plant in the original station consists of high-speed dynamos, with a total capacity of 3,400 kw. Three of the large lighting generators can be run on the tramway load, if required.

A view of the interior of the power station is given in Fig. 1.

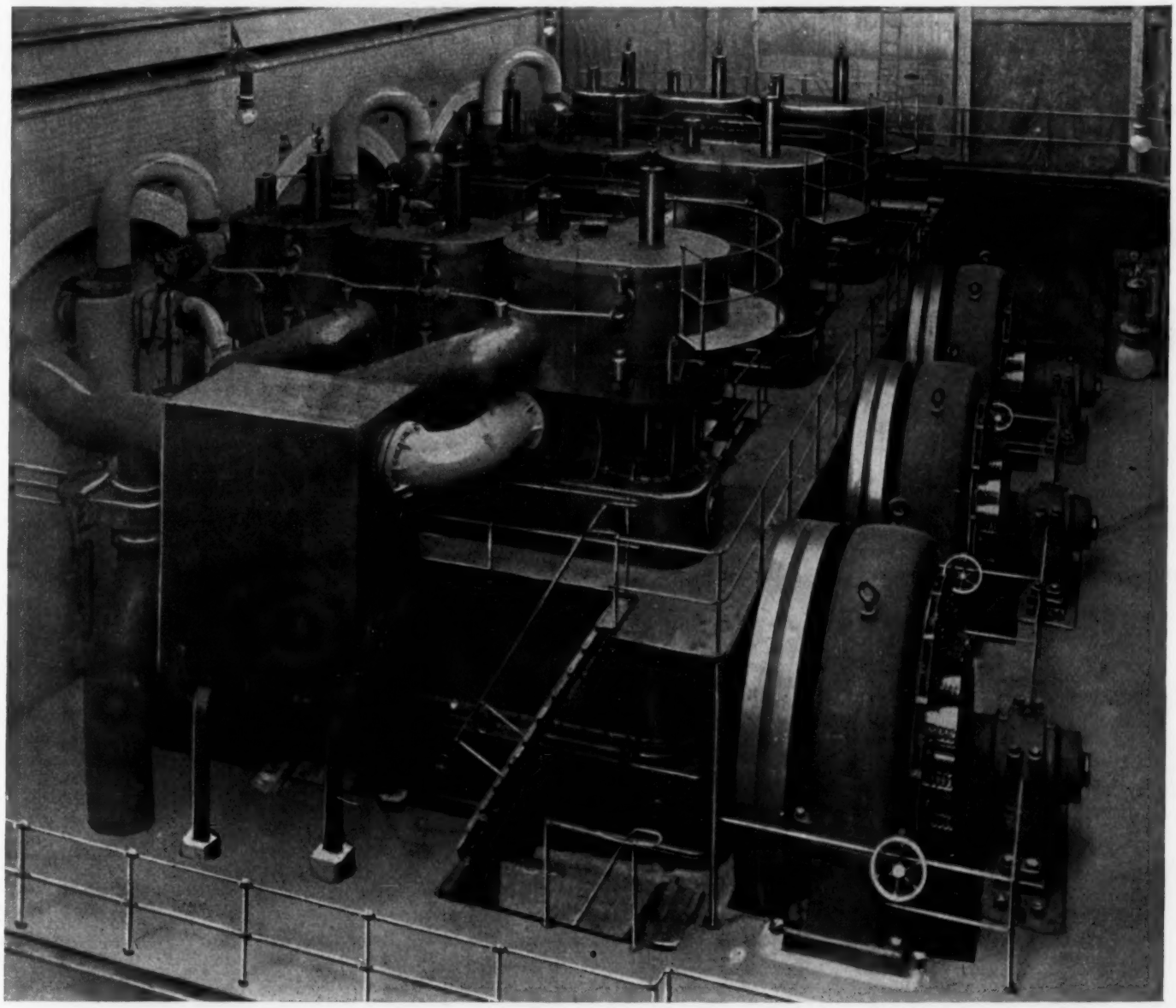


FIG. 1.—INTERIOR OF NEW ENGINE HOUSE, BELFAST ELECTRICITY WORKS.

The equipment in the railway extension consists of three 1,000-kw, direct-current units. The engines are of the vertical inverted three-crank, triple-expansion, enclosed type, with forced lubrication, made by Combe Barbour, Limited, of Belfast, and constructed to run at a speed of 180 r.p.m. with steam pressure of 170 lb. per sq. in., and 150° F. of superheat. The cylinder dimensions are 22 in., 33 in. and 50 in. by 24-in. stroke. The steam consumption at full load condensing under the above conditions of steam pressure and temperature, and with 25 in. of vacuum, is guaranteed at 16¾ lb. per kw-hour, subject to additions or deductions of £250 per engine for every pound of steam per kilowatt-hour below or above that figure.

The generating station also contains two 250-kw motor-gener-

ators, which are supplied with current from either the traction or the lighting circuits at a pressure of from 500 to 550 volts, and deliver 60-cycle, three-phase current directly at 6,000 volts

directly coupled to the three-phase generator, the two machines being placed on a common bedplate. A small continuous-current generator is provided on one end of the shaft for supplying field

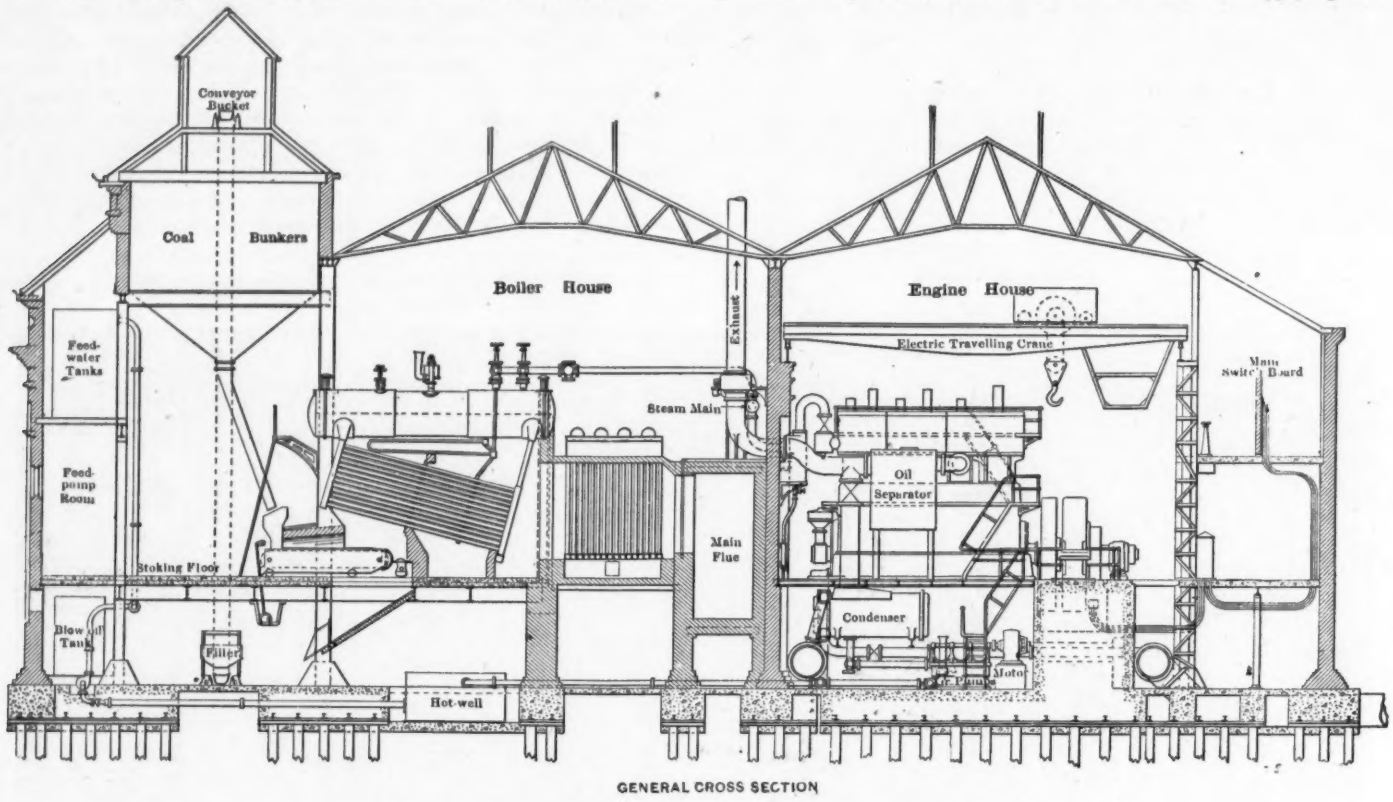


Fig. 2.—Cross-section of Extension of Power Station, Belfast.

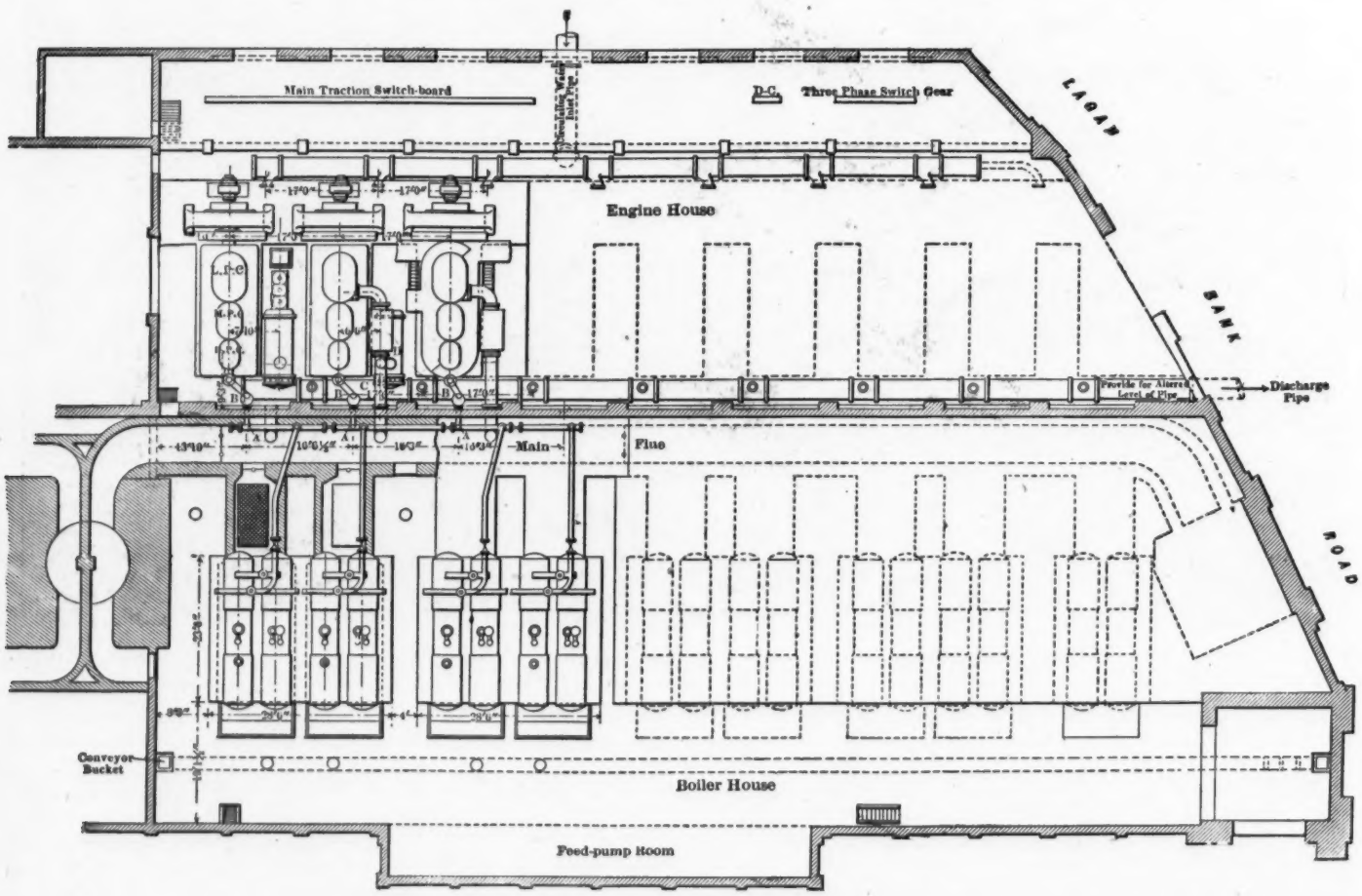


Fig. 3.—Plan of Extension of Power Station, Belfast.

for transmission about three miles to a sub-station at the Fort William Depot for the operation of the portion of the system in that district. The continuous-current motor of each unit is current to the three-phase machine. The sub-station equipment consists of three 125-kw, three-phase, synchronous motors directly connected to direct-current traction generators. Each of these

latter motor-generators is provided with a small starting induction motor mounted on one end of the shaft, in addition to an auxiliary exciting dynamo mounted on the other end of the shaft.

The chief feature of the high-tension switch gear is that all live parts are isolated from the operator, and the fire risk is reduced to a minimum. All metal conductors are entirely enclosed in masonry compartments. The oil switches are of the remote-control type, with a separate double-break switch in each phase. The switches are automatically opened by means of a trip coil, receiving its current through series transformers placed in the main circuit. Duplicate three-phase bus-bars are provided to which the various generators and feeders are connected through selector switches, so that either bus-bar can be made dead for cleaning or other purposes.

Provision is made in the sub-station for starting the motor-generators from the direct-current side. The sub-station is connected wtih the generating station by means of a duplicate three-core trunk main, the section of each core being 0.075 sq. in. These cables are lead-covered and armored and laid in earthenware troughs filled in solid with bitumen.

The main traction switchboard and the three-phase operating switchboard in the generating station are erected on a gallery which runs the full length of the engine room at a height of 12 ft. above the main floor level. The main switchboard contains the usual apparatus, including a Board of Trade panel. All

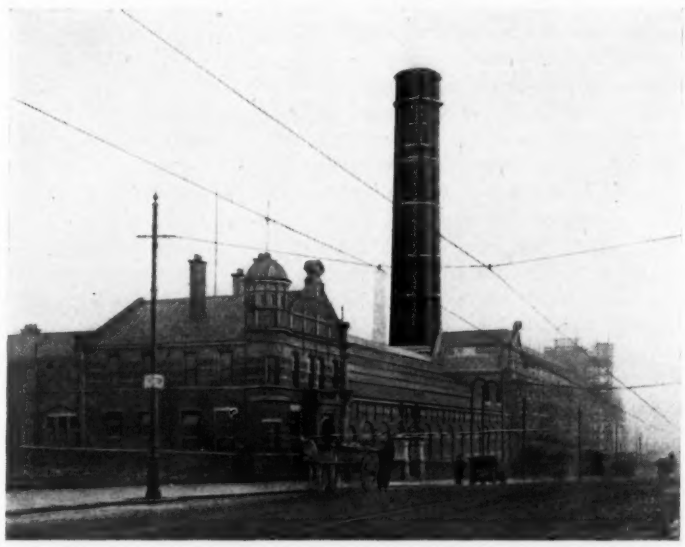


FIG. 4.—VIEW OF EXTERIOR OF BELFAST ELECTRICITY WORKS.

panels are of white Sicilian marble 2 in. thick. The over-all height is 92 in., and the total length of the board is 50 ft. The Board of Trade panel is equipped with Elliott instruments. A main three-pole throw-over switch in the circuit of each generator is mounted on a pedestal on the floor below the switch gallery, for connecting generators to the traction switchboard as compound machines, and to the lighting switchboard as shunt machines. The field circuit resistances are mounted below the gallery floor, and are operated by means of hand wheels erected in convenient positions in front of the switchboard.

Most of the auxiliaries in the boiler house are electrically driven. Each boiler is provided with a B. & W. chain grate stoker, the speed of the travel of which can be varied between wide limits, so as to meet any variable demand for steam. All of the stokers are operated by a line shaft beneath the stoking floor and connected by clutches to duplicate electric motors driving by means of worm reduction gear. The scraper gear of the economizers, which are of Green's make, are also driven through worm gearing by means of an electric motor.

Two of the three feed water pumps are electrically driven. These two pumps are of the Hayward-Tyler variable-stroke type, for which the following advantages are claimed: The pump can always be started at "no stroke," thus avoiding heavy starting current; no variation in speed is required; no electrical complications are introduced, and variations in delivery are made while the pump is running, without interrupting the feed supply, and by the simple movement of a small hand lever, which is held in position until the required rate of delivery is obtained. In order to enable the attendant to regulate the pump to the requirements of the boilers, an automatic indicator is fitted to the end of the shaft, which shows either the stroke in inches or the equivalent discharge in gallons per hour.

There are also installed at present three Guynne electrically-driven centrifugal pumps, two 12-in. and one 15-in., and provision is made for the erection of two more when required. Two sets of motor-driven charging apparatus are also provided for priming the pumps. These centrifugal pumps are used for raising water from the river for use with the condensers. The condensing plant is of the counter-current surface type, with three-throw Edwards air pumps, manufactured by Mirrlees-Watson Company.

Each main engine is provided in the basement with a separate condenser and an electrically-driven, three-throw Edwards air pump. The discharge from the air pump gravitates into a large cast-iron tank in the boiler house basement, and is lifted from there to the hot-well over the feed pump house by means of electrically-driven centrifugal pumps.

An exhaust steam grease separator is placed between the engine and the condenser. Each engine is also provided with an atmospheric exhaust controlled by an automatic valve which opens in the event of the vacuum failing, so that the sets can run non-condensing.

An electric locomotive crane is employed in transferring coal from the barges into a hopper of an "Ingrey" automatic weighing and recording machine, which discharges it into a receiving hopper underneath. From this hopper the coal passes by means of a chute with regulating valves into an automatic filler which fills the buckets of the conveyor without spilling. The coal is then elevated vertically (by means of the conveyor, which is of the continuous gravity bucket type) to a suitable height to cross the public road through a covered way into the building, above the level of the overhead bunkers, each bunker being provided with a pair of suitable dumping cams, so that the coal can be deposited where required. The conveyor is directly driven by a direct-current motor of the enclosed type.

The electrical car equipment, which was mentioned above, was supplied by the British Westinghouse Electric & Manufacturing Company. The overhead equipment was installed by J. G. White & Co. The general manager of the railway is Mr. Andrew Nance. Mr. V. A. H. McCowen is the city electrician and Mr. H. A. Cutler is the city engineer.

Luminosity of Electric Lamps.

In a recent issue of *Comptes Rendus*, Mr. P. Vaillant reports the results of some interesting observations on the relation between the power consumed and the spectrum luminosity in various types of electric lamps, including the mercury lamp, the carbon and tantalum incandescent lamps and the Nernst lamp. In the Cooper Hewitt mercury vapor lamp he made the curious observation that the greater the power the lamp consumes the yellower is the light. Measuring the luminous intensities at wave lengths 577, 546 and 492 $\mu\mu$, respectively, he found that when the power fell from 200 watts to 99 watts, the luminosities in those three regions fell from 1,000 to 341, 398 and 449, respectively, thus leaving a distinct advantage to the blue light at the lower power. Since the blue light preponderates at the higher temperatures in all other glowing bodies, the author is forced to the conclusion that the less the power consumed the hotter is the vapor. It is certainly true that the mass of mercury evaporated diminishes as the consumption of power increases. As regards the other lamps, they all shift their maximum of luminosity toward the blue at the higher powers, and the shifting of the luminosity occurs most suddenly in the Nernst lamp. Taking the luminosity of the carbon filament for each wave length as a standard, the Nernst lamp at ordinary working shows a deficiency both at the red and blue ends, and the tantalum lamp a great preponderance of blue over red.

Transmitting Distance in Wireless Telegraphy.

By Capt. L. D. Wildman, U. S. A.
Signal Corps, U. S. Army.

In the *Electrician* of London, for December 15, 1905, there is a very interesting article on the recent advance in wireless telegraphy, by J. Erskine-Murray, D.Sc., in the course of which the writer has attempted to deduce a formula for indicating the limit of distance in transmission.

After deducing the equation

$$C = M\left(\frac{k}{\sin\theta} - 7\theta\right)$$

where C = received current.
M = minimum current that will actuate receiver.
θ = angle subtended at center of earth by arcs over which transmission is taking place.
k = a constant,

he quotes Duddell's and Taylor's experimental results and ends by saying that this formula is doubtless very rough, and in many parts incomplete.

Many different formulas have been presented by different experimenters, but none of them appears to be of much value in designing a wireless plant to transmit a given distance. It is probably impossible to introduce into any formula the amount of absorption in the electromagnetic wave, by its propagation over any terrain where there exist natural objects. In other words, it is probable that no formula can be devised at present for wireless telegraphy over land. We must, therefore, confine Dr. Murray's formula to transmission over water, and probably over salt water.

From experiments conducted in Alaska, between the army stations at Fort St. Michaels and Safety Harbor, the present writer is of the opinion that Dr. Murray has left out one very important factor, which seems to have been generally neglected by everyone who has written upon the subject of wireless telegraphy. That factor is the absorption of energy from the aerial wire at the sending end, due to particles of water vapor, ice or snow driven against it (while charged to a high potential) by winds.

The experiments covered an entire year, during which were charted all of the atmospheric variables which appeared to have any effect upon this phase of the question, with the single exception of the percentage of moisture suspended in the air. This exception is an extremely important one, but during the major portion of the time in Alaska, the temperature was below 32°,

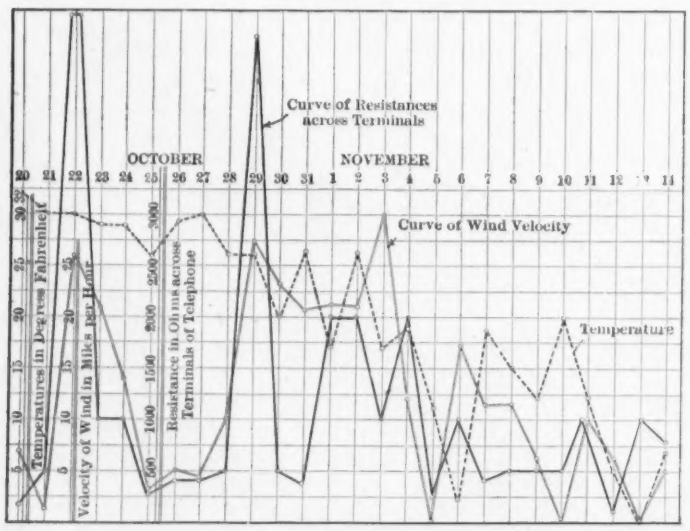


FIG. 1.—RECORD OF TESTS.

no instruments by which the amount of percentage of moisture, ice or snow could be determined was available.

The chart (shown in Fig. 1) covers a period of about a month, from October 20 to November 14, and it will be seen that the strength of the signals received decreased with the velocity of the wind to a very marked degree. The device used for determining the strength of the signals was very simple, but is believed to have been fairly accurate. It consisted of a variable resistance, placed across telephone cords, as shown in Fig. 2.

By reducing the resistance when signals were being received, the strength of these signals could be cut down to a point where they were just intelligible. The amount of this resistance varied on different days, and by recording the resistance a comparative record was thereby obtained. For instance, on the 21st of October there was little or no wind, the temperature of the air was just below freezing, and signals could be heard with a resistance of only 400 ohms across the receiver cords. On the next day the velocity of the wind was 30 miles an hour, the temperature was about the same as that of the previous day, but the signals could not be distinguished with less than 8,000 ohms across the cords. This day was an exceptional one, in that the air was full of driving snow. Similar occurrences show all the way through in a fairly constant manner, and the record for 365 days seems almost conclusive proof that the factor of moisture and wind velocity must be taken into account in any formula. The instruments used in these tests were very crude, as it was not originally intended to carry on this experimental work in Alaska. The moisture had to be judged without instruments, but the anemometer used was reliable.

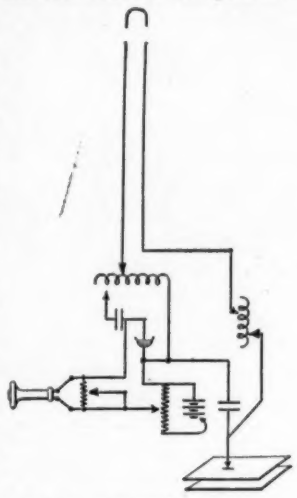


FIG. 2.—TESTING CIRCUITS

The electrical constants of the sending mechanism were recorded at both stations, but these were so uniform that they have been left off the chart. It was impossible to make these experiments at both stations at the same time, for the instruments were sufficient for one only. The effect, therefore, upon the receiving antenna, as well as upon the sending antenna, is as yet an unknown quantity, and there is much room for experiment upon this subject.

Concerning the method of obtaining the relative strength of signals, the writer is also quite well aware that the method used is somewhat crude, for the operator's hearing is probably less acute on some days than upon others, and he was also bothered by the fact that the operating room had no doors between it and the rooms where the squad lived. The operator could also hear the land line telegraph sounder, and in the next room was the 6-hp gasoline engine used to drive the generator. The building was also of poor construction for that climate, and had a corrugated-iron roof which made much noise during high winds.

The results, however, show such uniform fluctuation between the signals and the wind velocity that there seems to be no room for doubt concerning the general effect.

One important change was made on account of these experiments. The poles for the aerial in Alaska were planned and erected with an idea that 50 or 100 wires would be suspended from the cross stay, for the purpose of getting a large capacity for radiation. The aerial was, however, cut down to a small grid about 10 ft. in height, with but two wires connecting it with the sending apparatus. For, if it is correct that the energy of the aerial is lessened by the number of particles charged by it (and carried away) the effectiveness of the aerial is decreased in direct proportion to the number of wires in the aerial.

The mechanical difficulties with a two-wire aerial are very much less than those connected with a 50 or 100-wire aerial, particularly in regions where there are, at times, wind velocities of 90 miles an hour, and where the aerial may be thickly coated with ice and frost.

Referring again to Dr. Murray's formula, it is believed that in designing any two stations the maximum factor of dissipation of energy due to wind velocity and particles of moisture, ice or snow, must be taken into account when determining the value of C.

Advantageous Use of Highly Magnetic Metal in Radiation Conductors.

BY JAMES FOSTER KING.

THE employment of a structure having great magnetic inertia as compared with the admittance, for the radiator or reflector in a space telegraph transmitter constitutes quite an innovation in this method of communication, and as I have had occasion to perform some qualitative experiments along this line I feel constrained to offer the following deductions from the effects obtained.

With great reactance as compared with ohmic resistance, the effect of an excessive susceptance developing abnormal pressures in radiating antenna—especially at the free end and loops of the fundamental pressure waves—is well known in the art, and in referring to this particular method it may be said that owing to deficient electromagnetic inertia certain portions of the wave developed are liable to serious distortions due to foreign influence, although it is possible to develop an integrally perfect wave by increasing the relative distances through which foreign forces must work.

In order to secure good working efficiency with the approximation to a necessary sine wave shape it is of importance to have appreciable inductance per unit length of circuit traversed, and in the practice of the art it is held that in linear oscillators, the ratio of interior to exterior inductances along their length should be constant in order to secure uniform velocity of electrical redistribution along the reflecting surface. In closed circuit oscillators it is desirable to abruptly change this ratio along the length of circuit traversed in order to vary the velocity and thereby secure maximum kinetic energy from the potential energy involved.

It may be said that any method of increasing the kinetic energy without decreasing the admittance of the oscillator has the desirable effect of increasing the persistance of its oscillations.

In the use of bare copper wires of commercial conductivities for prime reflectors of oscillating currents, I have found, for sizes most generally employed, appreciable amounts of the current leaking into and uselessly heating the interior at frequencies higher than 10^8 per second. Usually when the strands in a cable reflector are numerous, thereby presenting a maximum amount of radiating surface to the surrounding medium, which in the case of air has inappreciable magnetic hysteresis, the amount of energy per cycle lost by radiation more nearly approaches that admitted from the supply so that this localized absorption is negligible.

The effect of plating the reflector with metals less dense than copper, offering less resistance to a high velocity distortion, allows a more perfect surface current conduction to take place. Plating a copper reflector with such a dense metal as silver, offering greater resistance to high velocity distortion, arrests penetration of the exciting energy and thereby produces a more perfect surface current. Each of these methods has effects limited by the physical constants of the metals employed and not by the controlling force of the exciting energy.

In order to develop maximum radiation per unit surface exposed for a defined amount of impressed energy it is essential to secure a strictly peripheral distribution of current on the reflector.

When charging an uninsulated cable suspended in air the electrical distribution on individual copper strands cannot be considered as strictly peripheral, for the ratio of the squares of the velocities of an electrical redistribution in air and in the mass of copper is smaller than infinity.

To develop a strictly peripheral current distribution and so obtain accurate values for both reactances per unit length of conducting shell, it is imperative that the velocity of propagation of electrical effects in the enveloping medium should be exactly approached by that of the surface current redistribution, and the velocity in space be infinitely great as compared with the rate of an actual change of state in the interior of the metal.

The linear ratio for a pure copper circuit immersed in an elastic medium of specific inductive capacity equalling unity is of the magnitude $3 \times 10^{10} = v$.

As it is impossible at the high frequencies employed to secure uniform current densities throughout the entire cross section of copper conductors of commercial conductivities and sizes owing to the demagnetizing fields developed in the interior by currents in the external layer of metal; it becomes possible to secure better efficiency by increasing the ratio of the square of the velocities of propagation of electrical effects on the two surfaces bounding the conducting layer in question to a value greater than v^2 thereby compelling a more perfect surface distribution of exciting current.

When the ratio of the reactances at the bounding surfaces is greater than the square root of the higher velocity, owing largely to the retarding effect of the magnetic field developed by the exciting current, there is imparted to the medium offering least resistance to high velocity distortion more energy than resides on the metallic surface.

One way to simulate this effect is to encase the metal reflector in a dielectric covering of greater specific inductive capacity than that of air and thereby increase the charge given to the local electrostatic field. All energy not expended in radiation and heating effects of resistance and hysteresis is in this case recoverable in the form of a dielectric discharge and reverse current on the metallic surface.

Where there is total recovery of effective energy from the electrostatic field, only the external magnetic field developed by current redistribution along the extended reflector is available to induce secondary effects in the distant receiving circuit.

A more effective way, however, is to retard the electrical redistribution and thereby force a moving charge to traverse a surface layer of minimum thickness which may be effected by an increase of constraining magnetic flux in the interior developed by unit exciting current.

In the use of highly magnetic metals for high frequency oscillation reflectors, the magnetic reluctance of the mass of the metal is very great owing to the naturally large value for coercive force. The magnetic reluctance to high velocity distortion, exhibited by metals having appreciable coercive force, so limits the lateral freedom to distortion of the interior structure as to render it electrically non-conducting.

A limiting feature of this method is in the great increase in effective resistance due to the decrease in cross section of the actively conducting surface layer.

By thinly plating a soft iron reflector with a more perfect alternating-current conductor such as tin the great increase in conductivity of the surface layer will allow a maximum exciting current for a given charge to traverse the surface metal—also strictly limiting appreciable current conduction to the reflecting surface.

Best efficiency may be obtained from a plated iron reflector if it is incased in a perfectly insulating cover having both inappreciable magnetic hysteresis and high specific inductive capacity.

A very important factor controlling the redistribution of the effective charge received by the reflector is the mode of application of the exciting energy. There are in general two modes of application employed in the various systems using alternating-current excitation.

Where the source of exciting energy is permanently connected to the reflector the charge received has time to permeate the reflector structure. In cases where the first effective oscillation is started by a fall of potential along the length of the reflector, caused by a sudden release from constraint of the surface component of the impressed charge, the swamping effect of interior currents coming into phase with the surface redistribution currents will blur very sharp sonority. The best way to reduce this swamping effect is to use insulated plated iron instead of bare copper for the reflecting structure.

When the reflecting structure is periodically connected with the exciting apparatus through a small spark gap by the formation of a highly conductive spark which makes connection only at the peak of the exciting wave, the redistribution of energy along the length of reflector depends on the instantaneous pressure value of the impressed charge and the reciprocal of the square of the velocity of surface current redistribution.

With reflectors of metal having appreciable specific heat capacity there is not time for an electromagnetic current penetration to occur in the natural period of oscillation of the exciting currents in the conducting shell.

It is best to employ a magnetically rigid metal such as iron or steel for the reflecting core and by plating this core with a superior electromagnetically conducting metal such as tin, it is possible to develop highest efficiency, irrespective of the mode of application, of charge, in the reflection of sonorous electric oscillations from a radiation surface.

Another Electric Power Scheme for London.

Another plan for the general supply of power to London will form the subject of a bill to be put before Parliament this year, and which is stated to have strong financial backing. The plan in brief is to generate electric energy at a convenient spot outside London, under the most economical conditions attainable, and to transmit it to London at high pressure along a private right of way after which it will be distributed along the railways and canals to bulk consumers. By this means it will be possible to reach every part of London without breaking up the streets or coming into contact with local authorities.

Two other schemes with similar objects in view have previously been discussed. One is to build large generating stations at the coal fields, suggested by Mr. B. H. Thwaite, but which has been criticized on the grounds that it would be too costly. The other is to build a large generating station in London, against which it has been urged that owing to the high cost of land, high wages, high rates and taxes and high cost of fuel and water in the Metropolitan area, the installation of huge generating stations within that area is impossible; and that even on the banks of the Thames a convenient site would be too costly, and strange as it may seem the cost of fuel at such a site would be too high.

The present scheme has taken an intermediate position; and involves the selection of a site where coal and water can be obtained at the lowest possible rates while the cost of the transmission line would still not be unduly heavy. It was estimated that, balancing the cost of haulage of coal against the capital charges of the transmission line the minimum annual expenditure could be approximately attained at a site between 40 and 60 miles from the Metropolis; and, after exhaustive investigation, such a site was found near St. Neots on the river Ouse.

Not only were the conditions favorable here as regards both fuel and water supply, but the Great Northern Railway Company, which naturally looked with a most friendly eye upon the scheme, possessed a large tract of land at this spot which could be had at a low price, and possessed a private right of way from Stevenage in Hertfordshire to Enfield in Essex, originally acquired for the construction of a railway, but not yet utilized.

St. Neots is 51½ miles from King's Cross, which is the London terminus for the Great Northern Railway; Stevenage is 28½ miles, and Enfield 9½ miles from King's Cross. The nearest available coal fields lie between 40 and 75 miles from St. Neots so that the railway company obviously stands to profit by the haulage of the coal; nevertheless it is calculated that the coal will be delivered into the company's bunkers at an inclusive price of 7 shillings ($1.75) per ton or even less. To accomplish this result, special means will have to be adopted, the coal being hauled in large bogie wagons and handled by machinery.

Besides the coal traffic the railway company would benefit in various other ways. The sleepy little town of St. Neots would be roused into activity, and with the prospects of cheap power, it is natural to suppose that manufacturers will be eager to secure sites for factories in the neighborhood of the power station and along the transmission line, just as they have done at Niagara, and are expected to do in the case of the Lancashire and Yorkshire Power companies' stations. The Great Northern Railway will want electric power for operating its suburban traffic in the near future and other railways will be equally ready to take a supply. Further, the Metropolitan Borough Councils may confidently be counted upon as bulk consumers, for their position as distributors will not be affected except favorably. Most of the power stations in the London area are situated upon either railway or canals and will, therefore, be directly accessible to this company's transmission line.

The engineers of this scheme are jointly Messrs. Harper Bros., and Messrs. Kincaid, Waller, Manville and Dawson, both firms of mature experience and high capacity for the organization of such an undertaking. It will be remembered that Messrs. Harper Brothers are engineers for the North Wales Power and Railway Scheme, which is now nearly completed, and that Mr. Philip Dawson, of the latter firm, is the consulting engineer entrusted with the electrification of the London-Brighton and South Coast Railway.

Most probably steam turbines will be adopted for the generating plant, the power station being of 60,000 kw capacity to start with and having an overload capacity of 90,000 kw. The power will be generated at 20,000 volts pressure in the first instance, though most likely it will afterwards be raised to 50,000 or 60,000 volts. There has been much discussion as to what is the highest pressure that is safe in the old country, taking into consideration the climatic conditions. Some engineers state that 30,000 volts is the highest pressure practicable; but others think that 50,000 or 60,000 could be used safely, as England has not the extreme ranges of temperature, the violent snow storms and blizzards, or perpetual fogs met with in some places where this pressure is used, such as the Sierra Nevada Mountains in California, the "Houille Blanche" region in Savoy, or other Mexican, Canadian, Italian or American districts; and the London area is almost the driest in the Kingdom. It is, therefore, anticipated that while operations may be commenced with a pressure of 20,000 volts, when the load increases the pressure will be raised to 40,000 volts at least.

The transmission lines will be carried overhead along the railway and along the private right of way above mentioned to Enfield, at which point a receiving sub-station will be erected. Thence underground mains at 20,000 volts will be employed, laid in a 6-ft. way, or along the towing paths of the canals.

These propositions have all been put forward with the approval of the Board of Trade, which, of course, is absolutely necessary in England with a scheme of this nature.

With regard to the financial aspect it is estimated that the works costs will not exceed .25 cent per kw-hour generated (reckoning on a load factor of 35 per cent). Under these conditions, the selling price to bulk consumers will be well under 1 cent per kw-hour, after providing amply for depreciation and reserve, and allowing for a dividend of 10 per cent upon the capital invested, which is estimated at $10,000,000 to begin with.

The project is stated to be well backed, and will have the support of the railway companies, most of the supply companies, many of the borough councils and a number of well known financiers, whose names will be a guarantee for the financial soundness of the scheme.

Explosion of Radium Tubes.

In the issue of *Physikalische Zeitschrift* for January 15, 1906, Mr. J. Precht describes some experiences with radium which tend to show the enormous force of the emitted gaseous products when they are confined to a limited space. He reports that a small glass tube with walls 0.5 mm. thick, containing 25 milligrammes of purest radium bromide, exploded after 11 months' use with a loud report. Three minutes before the explosion it had been removed from a bath of liquid air and placed on a wooden table. It had been used several times before. The force of the explosion was such that the glass was shivered into almost microscopic particles which were strewn all over the room, the radium being seen in the dark like a starry sky. The pressure in the tube must have been at least 20 atmospheres, and was no doubt due to the evolution of gaseous decomposition products of radium.

Gasoline-Electric Car.

The need, especially in sparsely settled districts where the cost of maintenance of a steam drawn train is prohibitive, and the investment of capital for an electric service is unjustified, for a self-contained car which shall be independent of a feeder system, and at the same time be cheaper to operate than the ordinary locomotive and train, has led the General Electric Company in conjunction with the American Locomotive Works, at Schenectady, N. Y., to design a gasoline-electric car as a solution for this go-between.

The first trial run of this experimental car took place February 3d, when a successful trip was made from Schenectady to Saratoga, N. Y., and return, over the lines of the D. & H. railroad. During the trip several important features of this method of driving were demonstrated. While the car was not designed for high speed, the average running time was about 35 miles an hour, and several times the car attained a speed of 40 miles an hour. The smooth and rapid acceleration was most favorably commented upon by the engineers present, as well as the complete absence of vibration which might be thought to accompany the use of a gasoline engine.

This car consists essentially of a gasoline-driven electric generator furnishing current to electric motors geared to the driving wheels and controlled by a method similar to that employed in the ordinary straight electric car equipment. The car in question, shown in the illustration, is of the combination type, comprising a passenger compartment, smoking room, a baggage room, engine room, toilet and a motorman's compartment. A complete controller equipment is located at each end of the car, the forward controller being located in the engine room. The car has seating capacity for forty passengers, including seats for twelve in the smoking room. In general it is built on the lines of a standard D. & H. passenger coach, and is handsomely finished.

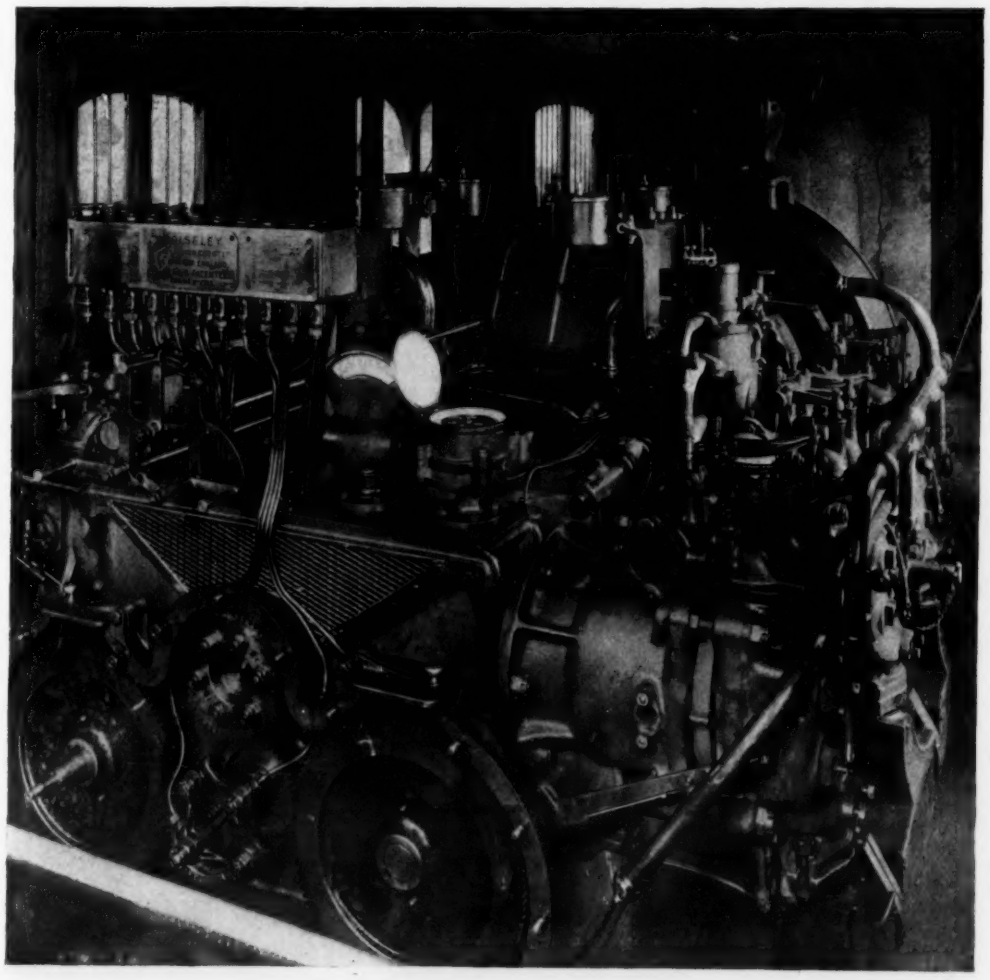


FIG. 1.—ENGINE ROOM OF GASOLINE-ELECTRIC CAR.

The gasoline engine for this car was built by the Wolseley Tool & Motor Company, Ltd., of Birmingham, Eng., and is considered the most powerful unit yet constructed for this class of work; it develops 140 brake horse-power when running at 450 revolutions per minute. The cylinders are horizontal, six in number, and arranged in three pairs, the two cranks forming a pair being at an angle of 180°. All valves are mechanically operated, and the cylinders are water-cooled. Hitherto difficulty has been experienced in starting internal combustion engines of this size, but in the present case this has been entirely overcome by using shells filled with black powder to provide the initial charge in one cylinder. On starting the engine the shell is fired by a hand trigger, the whole being similar to the breech mechanism of a gun. Jump sparks and low-tension ignition are both provided, current being furnished to the latter by a small magneto driven from the engine shaft. When speed is up the jump spark is cut out.

FIG. 2.—GASOLINE-ELECTRIC CAR.

The volatilization of the liquid fuel is produced in two carbureters which form an integral part of the engine. Each carbureter supplies three cylinders, and is equipped with two float feed chambers, one for use with gasoline and the other for kerosene if its use is found desirable. The chambers are identical and are of the usual needle valve type. Very flexible arrangements are provided to govern the air supply so that it may be taken from the atmosphere or from the crank chamber, or from both, according to the temperature required. The mixture is heated to the required temperature in a small chamber which itself is warmed by the exhaust. The whole design is so planned that kerosene may be substituted for gasoline by simply turning a three-way cock.

In all details the engine is very complete. The lubrication is especially so, being force feed for main bearings and pistons and drip feed for all other working parts. Gasoline is stored in steel tanks beneath the car, and the burnt gases pass through the

roof into mufflers from which they exhaust into the air. The cooling system for the cylinders consists of two sets of radiating tubes, one located on the top of the car, the other within, cooled by chain driven fans. Water for cooling is contained in the engine base. The heating system for the car forms a shunt with the cylinder cooling system.

Current is furnished by a 120-kw direct-connected General Electric six-pole unit, designed for 600 volts. This generator is provided with commutating poles, which in connection with the method of voltage control, permits a very flexible operating system. The advantage of commutating poles is evident when it is considered that the field excitation at starting is weak, and the large current at low voltage is required to give the necessary starting torque at slow speeds. Owing to the peculiar operating conditions of this system, the geenrator, while retaining the characteristics of a shunt-wound machine, is separately excited by a 5½-kw, two-pole, compound-wound exciter, working at 110 volts. This is located on top of the generator and is driven by a Morse silent chain.

There are two motors for the car, each designed to give 200 hp. These are of standard railway construction and need no special description.

For regulating the speed of the motors, as mentioned above, voltage control has been adopted; in other words, the speed of the car is governed by varying the field strength of the generator. With this method the speed of the engine remains constant after acceleration. The controller is semi-automatic, and can be set for any predetermined maximum acceleration. It is arranged for series-parallel control, the motor connections being changed from series to parallel by the reversing handle. This latter has five positions, "series ahead," "parallel ahead," "off," "series reverse" and "parallel reverse." Arrangements are provided to prevent the motor connections from being changed from series to parallel until the resistance is put into circuit.

Further operating details comprise a General Electric combination straight and automatic air brake equipment, and a special lighting equipment. Meridian lamps are used, equipped with "Holophane" reflectors, the whole affording a very satisfactory system for car lighting. The headlights are supplied with 100-cp incandescent lamps of the stereopticon type, one for each end of the car.

The trial trip demonstrated the practicability of this car equipment, and was entirely satisfactory to the engineers of both companies so far as the tests indicated. The opinion was expressed that this was merely a step toward the final electrification of all service. A gasoline car would be useful in establishing a passenger traffic, but eventually the motive power for operation would be electricity.

Protection of Telephones From Wireless Disturbances.

By C. R. Siegel.

The sending of wireless telegraph messages in some instances seriously affects the transmission of speech from telephones, protected by lightning arresters, located in the vicinity of wireless stations. The Morse signals cause a series of sparks, varying in length according to the signals sent, to jump from one or both arrester carbons through air-gap to grounded carbon. The signals are reproduced so plainly at the arrester and in the telephone receivers on the line effected as well as at other telephones connected therewith through an exchange, that one having knowledge of the Morse code can easily decipher the signals at either place.

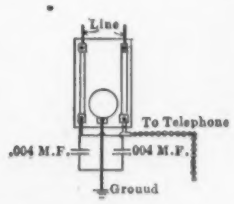
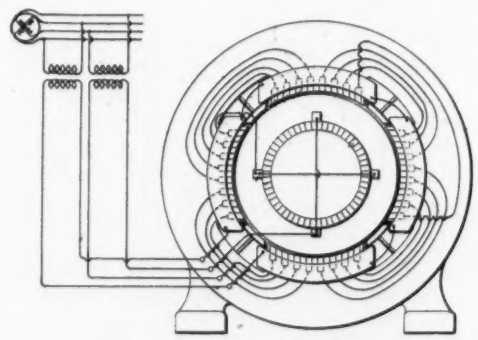


DIAGRAM OF CIRCUITS.

One remedy is to change the route of the telephone line from the zone of the ether disturbance, oftentimes at considerable expense. The sketch herewith shows a simple and at the same time inexpensive method of overcoming this trouble which has proved to be satisfactory. By its use the discharges are entirely eliminated, or rather dissipated, signals cannot be heard in the telephone receivers, and the transmission of sound is not impaired either locally or when connected with long-distance lines. Condensers of low capacity, approximately .002 to .005 microfarads, are connected between each side of line and ground, at or near arrester or point of discharge. Where two or more telephones are on the same line, the condensers are placed only at the instrument nearest the wireless station. The same results may be obtained by the use of Leyden jars.

Polyphase Commutator Motor.

In a patent issued January 30, 1905, to Mr. B. G. Lamme, is shown a method of operating a commutator motor by means of polyphase currents. One embodiment of the method is indicated in the accompanying illustration. The armature is of the four-pole type. It is connected in series with a stationary winding located in slots in the fuses of the field-magnet pole pieces and so distributed that the number of its ampere-turns in each pole face is equal to the number of ampere-turns in that part of the armature which is covered by the winding in such pole face. Thus the reactance of the two windings is reduced to a very low value. The armature and its compensating winding are supplied with current from one phase of a two-phase generator while the field winding of the machine is supplied with current from the other phase. The field magnetism is in electrical-time quadrature with the voltage impressed upon the field circuit, while the armature current is in phase with the voltage across its circuit. Therefore, the field magnetism and the armature current are in electrical-time phase, and being in electrical space quadrature they produce a torque at the armature. The machine possesses shunt motor characteristics with high power factor at the armature. The power factor of the field circuit is unaltered by the speed of the armature and since it is very low the polyphase circuits would always be out of balance. The inventor proposes to use low resistance plates to bridge the spaces between the tips of adjacent pole-pieces for the purpose of assisting in neutralizing the armature reactance and of preventing the "hunting" of the armature.



POLYPHASE COMMUTATOR MOTOR.

The inventor states that experience has demonstrated that the effect of the magnetomotive force of the armature current on the field magnetism may be so great under certain conditions as to set up a hunting action in the machine, during which the armature current rises and falls periodically. In such operation the magnetic effect in the interpolar spaces will also rise and fall periodically, and there will be a distorting effect in the field which will tend to cause the hunting action to continue. The low-resistance plates prevent the distorting effect, thus eliminating the hunting. The damping devices act also as a closed secondary to the armature as primary at the interpolar space, and hence they assist in neutralizing the armature reactance.

Modern Underground Construction.

At the recent meeting of the Northwestern Electrical Association at Chicago Mr. W. D. Burford presented a paper on underground construction as used by a new electric lighting and power plant at La Crosse, Wis. This paper is especially valuable because it gives the cost of such construction as actually carried on in the small city where the placing underground of electric light and power cables is done only to a very limited extent. Numerous companies throughout the country are in cities approaching a size which will soon call for a consideration of underground circuits. The following is an abstract of Mr. Burford's description of the construction employed and its cost:

The power house, which is located two miles from the center of distribution, contains two 400-kw Westinghouse, three-phase, 2,300-volt, 60-cycle generators, driven by steam turbines. The switchboard is arranged with separate light and power panels and all power feeders are kept entirely independent from the light feeders through the entire system. The wires leading from the power house are supported for a distance of two miles on 65-ft. Idaho cedar poles, each three-phase circuit being arranged in an 18-in. delta. The top arm has four pins and the second arm two pins, so arranged that each circuit occupies its side of the pole. At the extreme edge of the brick paved district the overhead line is dead-ended and the underground cable system begins.

The conduit used is the McRoy salt-glazed vitrified clay conduit containing four or six ducts. This conduit is laid in a trench on a 2x12-in. hemlock plank treated with a preparation of Carbolineum. On this plank and at right angles to it are 2x2-in. hemlock cleats 12 in. long laid at intervals so as to bring them four inches each away from the joints in the conduit. The conduit is then laid on the cleats and the joints between two sections of conduit are wrapped with a muslin strip four inches wide, saturated in water and overlapped in such a manner as to prevent the entrance of cement into the conduit. An iron mould eight inches wide and two inches thick is slipped down beside the conduit and tamped into position. The space thus formed between the mould and the joint is poured full of neat cement composed of equal parts of clean, sharp sand and Portland cement. Two more cleats are placed on top of the conduit four inches each way from the joint and filled with cement. This now forms a complete bond of cement two inches thick and eight inches wide, hermetically sealing the joints in the conduit. A 2x12-in. hemlock plank is placed on top of the completed work resting on the top cleat and serving as a protection to the conduit in case of future excavation.

The manholes having dimensions five feet in diameter by five feet deep from the street grade to bottom of manhole, are built of sewer brick laid in cement mortar. The circular brick work is eight inches thick resting on a concrete foundation seven feet in diameter and six inches thick. The bottom of the manhole is drained by means of three inch vitrified bell-end pipe twelve inches long imbedded in the center of the concrete foundation. Manhole covers are of cast iron of the standard size and ventilated type.

The lateral pipes which are used for conducting the cables from the manholes up the distributing poles are 3-in. wrought iron, bent in a 90-degree curve, painted with asphaltum varnish, and brought to a point three feet above the ground and securely stapled to the sides of the poles. They are fitted with a 3x25-in. reducer at this point and the pipes from here up to the discharge bells or pot heads are 2½ inches in diameter, painted and stapled in the same manner. The top of the pipes are fitted with a wooden bushing which is driven in around the cable in halves in such a manner as to prevent the entrance of water into the top of the pipe. These pipes are carefully cemented where entering the manhole in such a manner as to make it water tight.

The cables are furnished by the John A. Roebling Son's Company, of Trenton, N. J., and are of the three-conductor, paper-insulated type, especially designed for three-phase systems of an e.m.f. of not less than 5,000 volts between conductors. Each wire is separately insulated with paper 3-32 of an inch thick, which is saturated with a heavy insulating oil. The interstices are filled with jute and the whole core is protected from the lead by a paper belt 2-32 of an inch thick. The lead sheath is 1/8th of an inch thick and contains three per cent of tin. The copper conductors consist of stranded wire to insure flexibility. The insulation resistance of these cables on the reels was guaranteed to be not less than 60 megohms per mile at 60 degrees.

The primary service boxes were furnished by the H. W. Johns-Manville Company. Each consists of a cast-iron box with a hinged cover, fitted with lugs which engage a toggle bolt and thumb screw, allowing the cover to be bolted firmly down to a rubber gasket. The box contains a porcelain lining in which are mounted the spring clamps for holding "Noark" fuses, the porcelain cover of the inner box being equipped with the lobster claw clutch which permits of the fuse being removed while under load without any danger to the lineman. The inner box is also fitted with rubber gaskets and the rubber covered wires are led in through the bottom through porcelain tubes, the whole making a perfectly water-tight box.

At various points in the outer limits of the underground districts are lateral poles where the cables connect with long aerial lines supplying the residence districts. At all such lateral poles the cables are terminated in discharge bells as above described, the rubber-covered leads being directly connected to three-phase Westinghouse outdoor-type oil switches, which are mounted in a similar manner to the transformers. This construction allows the linemen to disconnect any section in case of repairs or extensions.

In addition to bonding the cables in every manhole there is a No. 4-0 wire strung aerial from the end of the underground district to the grounded side of the generators of the street railway company, this conductor being securely bonded to the sheath of the cables in the first manhole. This precaution is taken to prevent damage to the sheath of the cables from electrolysis.

TABLE I.—COST OF LAYING MULTIPLE DUCT CONDUIT PER LINEAL FOOT.

No. of ducts.	Labor.	Mat'l.	Repaving—Brick.	Repaving—Macadam.	Sand.	Total.
4	$.25	$.39	$.39	$.20	..	$1.23
6	.28	.57	.39	.20	..	1.44
8	.45	.65	.39	.20	..	1.69

These prices are based on 2x12-in. hemlock planks for foundation for the conduit with a similar plank covering the work—hemlock at $20 per thousand; Portland cement at $1.60 per barrel. Conduit layers at 30 cents per hour; trenchers and common laborers at 17½ cents per hour; conduit at 5 cents per duct foot.

TABLE II.—CABLE COST PER FOOT.

	Underground—Cable cost.	Underground—Cost of Pulling	Underground—Total	Laterals—Cable cost.	Laterals—Cost of Pulling	Laterals—Total
100,000 C. M. 3 conductors cable	.473	.12	.593	.473	.17	.643
No. 4 B. & S. conductors cable	.253	.12	.373	.253	.17	.423
No. 6 B. & S. conductors cable	.209	.10	.309	.209	.17	.379
No. 8 B. & S. conductors cable	.178	.10	.278	.178	.17	.348

Following is a table of costs on distributing poles fitted with 2-2½ inch pipes 25 ft. from the ground and fully equipped and wired ready for transformers and service wires, not including cost of transformers:

TABLE III.

	Equipped for light Transf's.	Equipment. for power Extra cost	Total.
50-foot 8-inch top Idaho pole set including steps, ground plate and wire ready for cross arms	$19.36	....	$19.36
Cross arms, pins, glass and braces for both distribution and transformer arms. All arms special Washington fir	12.87	$5.06	17.93
Service boxes and lightning arresters and connections	19.52	19.52	39.04
Wire, material and labor for connecting transformers to distributing arms	8.58	9.20	17.78
Angle iron platforms complete	7.90	....	....
2-2½ inches iron pipes complete with staples and wooden bushings	17.00	....	17.00
2-3-inch iron pipes from manhole to distributing pole complete with curved staples, reducers and alley repaved. Based on average of 14 feet from manhole wall to pole	35.46	....	35.46

The question of costs as it presents itself to the average manager is too generally answered off hand without any engineering consideration, and the underground proposition is turned down on the ground of excessive first costs.

It is a fact, however, that the question of costs is one which must be met sooner or later, and a careful analysis, taking into consideration interest, depreciation and maintenance, may reveal an entirely different situation than that which may first be imagined. To this end, and in order that a tabulated form may be had by means of which central station men may arrive at the actual cost of contemplated work, the above figures taken from the daily labor reports and material sheets are furnished for their information.

Mr. G. B. Springer, civil engineer of the Chicago Edison Company, in discussing the paper gave the following data on conduit construction in Chicago: The principal qualifications of a good conduit are practical indestructibility and freedom for disintegration from fire, water, acids, alkalies or electrolysis. A smooth inside surface is desirable to permit of easy drawing in of cable; also a style of conduit permitting of economical installation in crowded streets. The vitrified clay conduit has so far been found to be the kind most nearly attaining these requirements. These conduit are made in both single and multiple duct, the single being about 3.5 in. in diameter, or 3.5 in. square, and 18 in. long. Multiple conduit is made in two, three, four, six and nine duct sections, two to three feet long.

The single-duct conduit is best adapted for use in streets crowded with gas, water and other pipes, as the conduits may be divided into several layers crossing over or under the many obstructions found in the streets of large cities. A conduit construction which is made up of single ducts where each horizontal and vertical joint is broken, also has the additional advantage of preventing fire from spreading from one duct to another as might occur in multiple conduit. The multiple conduit is, however, well calculated to be used in outlying communities where there are not many obstructions, particularly in lines of from two to four ducts. This style of conduit is somewhat cheaper to lay than the single duct.

In laying the conduit a trench is dug sufficiently wide to allow three inches of concrete to be placed on each side of the ducts, and of sufficient depth to allow at least 30 in. of concrete on top of the top layer of concrete. Three inches of concrete is laid in the bottom of the trench also, thus insuring a concrete protection of three inches on all sides of the ducts. The trench is graded from some point near the middle of the block to the manhole at each intersection, or from one manhole to the other, as the case may be, at a gradient of about 2 in. or more to 100 ft. of trench.

In laying the single duct tile the ducts are placed close together, the joints and triangular spaces in the corners being plastered and filled with cement mortar, of a mixture of one part cement to one part of sand. A wooden mandrel about four or five feet long and three inches in diameter with a rubber or leather washer from three to eight inches larger on one end is drawn through each duct as the conduit is being laid; this is to insure any foreign particles or cement which may have gotten into the joints being drawn out. It also insures a good alignment.

A bricklayer is generally used in installing the single-duct conduit, the cost being slightly more for a bricklayer and helper than for three ordinary laborers as used in placing the multiple conduit. A good man, however, will lay from 1,600 to 2,200 duct feet of single-duct conduit in an eight-hour day.

Practically the same standard of construction is followed on all lines from two ducts up to twenty-five ducts, as many of these small duct lines, say from four to six ducts, extend for miles to outlying districts and frequently contain transmission lines of 9,000 volts.

In regard to the cost of conduit construction, as Mr. Burford says, there are many varying figures given off-hand. Indeed the vast difference in local conditions makes it very difficult to give a set of figures which will hold good in many places or in fact in the same place under different circumstances. There are often obstructions causing several feet difference in depth of trench, additional material and labor required, etc., to be considered as well as variations in cost of material, labor and number of ducts installed.

The following table, however, is submitted as a guide in approximating the cost of work of this character as a result of conduit construction covering ten years in Chicago. The cost of manholes is not included in this table, but is given in the one following:

Table for estimating cost of conduit, per duct foot, in different groups, in various pavements:

Kinds of pavement.	Number of ducts.								
	2	4	6	9	12	16	20	25	30
No pavement	$.18	$.18	$.18	$.18	$.18	$.18	$.18	$.18	$.18
Macadam	.24	.21	.20	.20	.19	.19	.19	.19	.19
Cedar	.26	.22	.21	.20	.20	.19	.19	.19	.19
Cedar reserve and granite.....	.31	.24	.23	.21	.21	.20	.20	.20	.19
Granite reserve	.43	.31	.28	.24	.24	.23	.22	.21	.21
Asphalt and brick reserve	.68	.43	.37	.31	.29	.26	.24	.24	.23

The following table contains approximate figures based on conditions prevailing in Chicago, and may be used as a guide in estimating the cost of conduit construction in connection with the table preceding:

Table for estimating total cost of manholes in different kinds of pavements:

Kinds of pav't.	Size of manholes in feet									
	3x3′	3x4′	4x4′	4x5′	5x5′	6x6′	6x7′	7x7′	8x8′	9x9′
No pavement ..	$41	$47	$53	$64	$109	$133	$142	$160	$189	$222
Macadam	42	48	55	66	111	135	146	163	193	226
Cedar	43	49	56	67	112	136	146	164	194	227
Cedar reserve and granite ..	44	50	57	68	113	138	149	167	198	231
Granite reserve.	46	53	60	72	117	144	155	174	207	243
Asphalt and brick reserve..	50	58	67	80	126	156	168	188	224	264

The above figures are based on the same prices for repaving, labor, bricklayers, cement and sand, as given in the table for conduit, and upon the following unit prices:

Brick work including labor and material	$12.50 per cu. yd.
Concrete tops and bottoms	$7.50 per cu. yds.
Back water gates	$6.50 each
Sewer grates	30 cents each
Sewer connections	$12.50 each
Sewer permits	$5.50 each
Manhole frames and covers	$15.00 each

Mr. Lukes said that there was a tendency to force electric light companies to put wires underground not only in cities of 25,000 to 50,000 inhabitants, but in smaller villages. It is rarely in these smaller towns justified by the income per mile of main, but it is necessary to please the public. The value of Mr. Burford's paper is apparent, in that it describes in detail a system of underground construction, telling not only how the work is done, but what it costs. The method described of having distributing poles located in the center of each block is by far the most economical and is practically standard in small towns. In congested city business districts it is necessary to put in a system of mains on the streets for individual service. It had been the policy of his company not to economize on main conduit lines. If it must economize, it did so in the outlying districts. For instance, in suburban districts where it is a matter of getting one or two feeders underground, it had used new sewer pipe to a large extent with cement around the joints. For main lines consisting of from four to twelve ducts, he believed it a good plan to surround the conduit entirely with concrete. If this is done, the conduit should be in shape to be used 25 years from now. He spoke favorably of the G. & W. pot-head for connecting overhead lines to cables on the poles. (This was recently described in the Electrical World and Engineer.) He said the cost of pot-heads made up as described by Mr. Burford was from $18 to $22 each, but the G. & W. porcelain pot-heads can be put up for very much less.

Mr. George Cutter asked for the opinions of central station men as to the best methods of connecting arc circuits in poles when coming from underground service and whether they favored a cut-out switch at the base of the pole or at the top near the lamp.

Mr. Lukes said that his company did not put in any switch at all. It connected the cable with the overhead wire by means of porcelain pot-heads of the type above referred to.

Mr. H. B. Gear, one of the inventors of the porcelain pot-head mentioned, upon request, gave further details about it. He reviewed some of the troubles experienced by the Commonwealth Electric Company in Chicago with ordinary pot-heads. The practice had been to take the cables off the pole in an iron pipe and make the joint to the overhead wire in a piece of 2-in. lead pipe

filled up with "Mineralac." In some cases, these joints were enclosed in wooden boxes to protect them from the weather and in others they were left outside. The wooden boxes were found to be a source of more danger than protection. In case one joint broke down, the fire inside of the wooden box would burn the top off the entire pole, so that the pole would have to be reconstructed. In developing the new pot-head, the idea was to get a porcelain sleeve instead of a lead sleeve and so keep the grounded lead sheath further away from the live conductor. Furthermore, it was desirable to have some means for readily disconnecting the overhead and underground line for testing and other purposes. He then described the methods of installing his pot-heads, some 300 of which were placed in service in Chicago last year. The expense of installing these devices is nominal, both for labor and material, because any ordinary lineman can do the work.

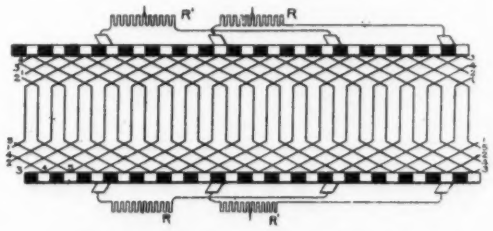
Mr. Cutter described a case in which trouble had been experienced with cut-out switches for arc lamps located in the base of iron poles due to the condensation in the pole, and to the moisture and rust which covered the switch.

Mr. Almert called attention to the trouble sometimes experienced from the freezing of water in the bend of the iron pipe in which the cable is led up the pole. When water collects in this bend and is allowed to freeze, it will in time compress the lead sheath enough to break down the insulation. He said that, as a general thing, arc lamp cut-outs located in poles where there was cheap construction were not successful and had been omitted because of the troubles with them, no work being done on live arc lamps under such circumtances. The later types of switches which were made entirely of porcelain with sufficient distance from the current carrying contacts to ground had been fairly successful.

Attention was called by President Williams to the boiling out of the insulating compound which sometimes occurs at pot-heads, no reason being apparent. Several others had noticed the same phenomenon, but no one could explain it to his satisfaction. Mr. Burford, in the case of some cables, thought it might be due to the oil insulation of the cable, and the contraction of the lead sheath forcing the oil into the pot-head. This did not explain many cases, however.

Non-Sparking, Alternating-Current Commutator Motor.

Mr. Marius Latour on January 30, 1905, obtained a patent for a method of preventing sparking in commutator motors. The inventor arranges the brushes so that no coils are short-circuited and yet the armature is not open-circuited as the brushes pass



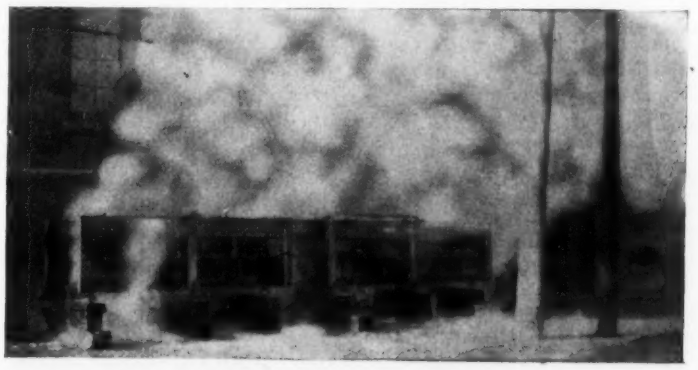
DEVELOPMENT OF ARMATURE WINDING.

from segment to segment. The commutator has alternate live and dead segments, and several brushes of each polarity are distributed around the commutator, each brush having a width no greater than that of a commutator segment as shown in the illustration herewith. The circuit through the armature is always closed, although the circuit through each brush is alternately opened and closed, because there is employed a second set of brushes connected in parallel with the first, so arranged that one set is in engagement with live segments at the instant that the other set is in engagement with dead segments. Sufficient resistance is inserted between the parallel-connected brushes to limit the short-circuit current to any desired amount, and provision is made to decrease the amount of this resistance as the motor comes up to speed.

High-Potential, Large-Capacity Water Rheostats.

The accompanying illustration shows two water rheostats used to dissipate the energy delivered by a 2,000-kw, 2,200-volt, two-phase turbo-alternator, in a test to determine the heating of the machine under continuous load. Each rheostat consists of about 1,000 gallons of water contained in a canvas-lined wooden tank 10 ft. long, 4 ft. wide and 3 ft. high, constructed in such a manner that it can be easily set up and taken down, thus making it comparatively portable. In the center of each tank are placed two iron plates electrically connected to form one terminal of the rheostat. At each end of each tank is placed a similar plate of iron, the two plates being joined together to form the other terminal of the rheostats. The resistance of the rheostat is adjusted by moving the end plates toward or away from the center plates, as desired. After the plates have been placed in the proper position, the resistance remains constant without any further adjustment on account of the fact that the quantity and quality of water are kept constant by providing a continuous flow through each tank at such a rate that the height is unaltered by the rapid evaporation.

These interesting rheostats were devised by Mr. F. M. Farmer, of the Electrical Testing Laboratories, for use in connection with an acceptance temperature test on a 2,000-kw turbo-alternator, sold by the Westinghouse Electrical & Manufacturing Company to the New York & Queens Electric Light & Power Company, of Astoria, Long Island City. Two tests were made in which these rheostats were used, one at normal load—1,000 kilowatts and 2,200 volts per phase for nine hours and the sec-



WATER RHEOSTATS IN SERVICE.

ond at 25 per cent overload—1,250 kilowatts and 2,200 volts per phase for nine hours. The service conditions were such that nine hours was all the time that the machine was available for testing purposes, arrangements being made to connect in the water rheostats immediately after the night light went off in the morning. Furthermore, the fluctuating load in the power house would have been unsatisfactory for the test.

In the conduct of the test, the change in resistance of the armature and field windings of the alternator was taken as a measure of the rise in temperature of the machine, thermometers placed in the air intake and outlet being also employed to serve as a check on the resistance measurements and to indicate the service performance of the machines. The path of the air through the machine is completely enclosed, and the air is forced through the windings and core by the motion of the rotor.

It has been found desirable to enclose the generator in order to eliminate from the engine room the excessive hum which accompanies the high speed incident to direct connection with a steam turbine. By use of forced draught with well designed intakes and outlets the decrease in the capacity of the alternator in comparison with what would be obtained in an open structure is inappreciable, while the noise is rendered unobjectionable.

We are indebted to Mr. Wilson S. Howell, of the Electrical Testing Laboratories, and to Mr. E. H. Witherall, of the New York & Queens Electric Light & Power Company, for numerous courtesies extended in the preparation of this description.

Letter to the Editors.

High-Voltage Direct-Current Traction.

To the Editors of Electrical World:

Sirs:—The recent articles that have been printed setting forth certain claims as advantages of alternating current over direct current for railway purposes have, of course, attracted universal attention, owing to the national reputations of the two gentlemen, Messrs. Westinghouse and Sprague, and the writer merely asks the privilege of "cutting in" at this time to incidentally suggest to the gentleman on the alternating side that, in view of the fact that they are strict believers in "cycles," it may not be out of place to call their attention to the fact that Mr. Sprague is now approaching the second "cycle" of prophecy, if I may be allowed to use such a phrase, and history may repeat itself.

Those of us who were fortunate enough to know Mr. Sprague in the early 80's will not soon forget his prophecy in regard to electric transmission of power, and his first success as a prophet, as far as the public recognizes the fact, became known in 1887, and about everything that he had been told so universally that he could not accomplish, he was in a fair way to demonstrate that he could. In 1897 his second prophecy developed; we are now approaching 1907, and the writer, for one, believes that, before the close of that year, it is very probable that the public may once more become acquainted with Mr. Sprague's prophetic instincts, and recognize the fact that although Mr. Sprague cannot "run a train around a square corner, nor possibly climb a tree," he can satisfy the general public, that he has a slight idea of what he is talking about when he touches on the subject of electric transmission of power.

It may be presumption to attempt in the slightest degree to outline the possibilities that lie within Mr. Sprague's intellectual capacities, but the writer believes that Mr. Sprague will surprise some of our alternating friends on the subject of direct-current railway work.

The writer is a thorough believer in Mr. Sprague, when it comes to a question of transmission of power for railway purposes, and having known him for many years, has yet to learn of his making any serious break, when he took it upon himself to talk on the subject matter in hand.

New York City. Frémont Wilson.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Calculation of Electric Machines.—Solberg.—A note giving a formula of universal application for the calculation of all kinds of electric machines, operating on the principle of electromagnetic induction. This formula for direct current states that the capacity in kilowatts, $Kw = 4n\,\phi\,AW \times 10^{-11}$, and for alternating current, kilovoltampere, $Kva = \sqrt{2}\,\pi\,f_u\,f_w\,n\,\phi\,AW \times 10^{-11}$. In this formula n is the frequency, ϕ the magnetic flux surrounded by one winding, AW the total number of ampereturns of armature or stator or transformer core, f_u the form factor of the e.m.f. wave and f_w the winding coefficient. This formula is of general validity. To apply it in practice, it is preferable to replace the total flux, ϕ, by cross-section multiplied with flux density and to substitute ampere-turns per cm. multiplied by length for the total ampere-turns. The formula enables one to make useful comparisons between machines of different types, for instance between direct-current motors and polyphase induction motors.—*Elek. Zeit.*, January 18.

Calculation of Dynamos.—Isambert.—A mathematical article giving a method for predetermining quickly the approximate dimensions which the principal elements of a dynamo must have in order to make the cost of the material a minimum. The method is stated to have proven useful in practice for an approximate advance calculation or for checking in a general way the dimensions which have been arbitrarily chosen.—*L'Ind. Elec.*, January 10.

Single-Phase Commutator Motors.—Niethammer.—The first part of what promises to be a long paper illustrated by diagrams giving "the exact theory of the commutation and exact diagrams of single-phase commutator motors." The author first gives the general theory of single-phase commutator motors, without making any distinctions between the different types. He then discusses the torque and deals with the problems of commutation and the methods of avoiding sparks.—*L'Eclairage Elec.*, January 20.

Calculating the Coefficient of Self-Induction of Coils Embedded in Iron.—Wittek.—For the determination of the dimensions of alternators it is very important to calculate as exactly as possible the armature stray field and the e.m.f. induced by it. The author gives a mathematical method which enables a calculation of the coefficient of self-induction of coils embedded in iron with an exactness sufficient for practical work.—*Elek. Zeit.*, January 18.

Induction Motors.—Sumec.—The first part of a mathematical paper on the armature reaction in polyphase induction motors. After general introduction the author gives the voltage diagram of the generator and formulas for calculating the excitation.—*Elek. u. Masch.*, January 21.

A 500-Volt Generator Set.—Nutting.—An account of a generator set arranged to make the use of storage batteries unnecessary for all kinds of vacuum-tube work and even for accurate conductivity tests. The set consists of 10 units, each of 500-volt bipolar shunt-wound 110-watt dynamos driven by a 2-hp motor.—*Bull. Bureau of Standards*, No. 3.

Lights and Lighting.

Spectra of Electrical Conducting Gases.—Nutting.—The third of a series of papers on the subject of the preponderance of one spectrum over another in a mixture of two spectra. The two spectra discussed in the present case are that of the electrodes and that of the gas atmosphere in an arc. The results show that the same general laws hold for the distribution of the spectral energy between electrodes and gas as hold for other mixed gases. The amount of electrode vapor present depends upon current and electrode fall of potential, being a surface effect proportional to the energy used in metal gas conduction. The conditions favoring a pure gas spectrum, free from the spectrum of the electrodes used, are (1) small current density at the electrodes, (2) substance of electrodes to be of some metal like aluminum, copper, or platinum showing small vaporization, (3) electrodes to be at a considerable distance apart and only the middle portions of the discharge are to be used. Gas density, capacity, inductance, series spark, and other conditions have but little effect, and hence may be adapted to other requirements. All three conditions above stated are realized in the Plücker tube, the loss in luminosity caused by the use of small currents being compensated for by the central constriction. In the ordinary arc or spark under the most favorable conditions, it is difficult to obtain a gas spectrum more than 80 per cent pure, whereas by decreasing the current and separating the electrodes, practically 100 per cent purity may easily be realized. To obtain a pure electrode spectrum, we must have (1) large current density and (2) electrodes near together. Oxygen appears to be the most favorable gas to use with the majority of metals, probably on account of the greater cathode and anode fall of potential in this gas. The above conditions are realized in the arc and spark, 95 per cent purity being easily obtainable.—*Bull. Bureau of Standards*, No. 3.

Mean Hemispherical C. P.—STEINHAUS.—For the comparison of the different types of lamps the mean spherical or hemispherical c.p. must be used. But with arc lamps a comparison on the basis of mean hemispherical c.p. may lead to entirely different conclusions for practical purposes. The author begins to discuss an example showing that even with one and the same type of arc lamp—in which the position of the maximum of emission of light is changed by varying the diameter of the carbon or the material of the globe—a comparison on the basis of the mean hemispherical light intensity may lead to erroneous results.—*Elek. Anz.*, January 20.

Power.

Water Power in Switzerland and Other Countries.—The Federal Councils of Switzerland have presented to the assembly a proposition to forbid the selling of electrical energy generated from water powers from Switzerland to other countries without special authority from the State. This authority will be granted only as long as there is no use for the power in Switzerland itself and shall be granted for limited periods not over 20 years. The Federal Councils may revoke the franchise, but must then grant an indemnity.—*L'Industrie Elec.*, January 10.

Pumps.—HERZOG.—The first part of an illustrated article on Sulzer high-pressure centrifugal pumps for which an efficiency of not less than 80 per cent is claimed.—*Elek. Zeit.*, January 14.

Traction.

Alternating-Current Traction.—BELL.—A general discussion of the problem. Alternating-current traction has its chief and commanding advantage in the greatly simplified distribution, an advantage that rises in importance with every extension of electric traction into wider fields. Concerning the Leonard system the writer says that it has a very perfect and delicate speed control and a high efficiency. "It is, however, open to the objection that the equipment required cannot be stowed away under a car, and gives considerable weight to be carried. If the very ingenious 'permutator' recently developed abroad should meet the hopes of its friends, the weight situation would be very greatly relieved, and the fact is that for the heavy railway work in which locomotives are desirable the Leonard system has some extremely strong points which it is not the part of wisdom to overlook." For ordinary routine work it has been necessary to turn to the single-phase commutator motor. The general principles of its design are outlined. "The single-phase alternating-current motor has two inherent difficulties which no amount of finesse can entirely circumvent. In the first place, there is necessarily a loss from hysteresis in the iron and from residual eddy currents that renders the machine clearly less efficient than a direct-current motor of the same output, by an amount that may be roughly estimated at between 5 and 10 per cent. Secondly, owing to the fact that the energy supply derived from a simple alternating current is intermittent, the output of such a motor is, other things being equal, less than that of a direct-current motor of the same effective weight of material, by 25 per cent, more or less. As single-phase motors are practically built, the great care in design and the high grade of magnetic material used tend to lessen the differences both of efficiency and of weight here referred to, the inherent disadvantages being thereby transferred to the cost." If the experiment on the New Haven road succeeds and "if the single-phase locomotives now under construction come fully up to their requirements, the work of heavy electric traction is likely to be revolutionized."—*Eng'ing Mag.*, February.

Combined Gasoline and Electric Automobile.—HOSPITALIER.—An illustrated article on the type of automobile in which a gasoline engine is employed in combination with a dynamo and storage battery, the dynamo and battery being used only as reserve and for furnishing power at starting and on grades. An automobile of this type recently exhibited by Pieper in Paris is described in detail. The gasoline engine and the dynamo are mounted on the same axle, and the latter, which is shunt-excited, is connected to a storage battery. The dynamo operates either as motor or generator according to whether its e.m.f. is smaller or greater than that of the battery. A great variation of power is therefore obtainable. The battery is always maintained in state of charge in the same manner as in tramway stations. The dynamo is supplied with interpoles and this construction permits variation of the speed by changing the excitation by means of the controller. The speed may thereby be changed from 400 to 1,600 revolutions per minute. The construction is described in detail and illustrated.—*L'Ind. Elec.*, January 10.

Installation, Systems and Appliances.

Central Station and Tramway Statistics in England.—The second sheet of annual statistics. It contains a table of 19 towns in the United Kingdom taking electricity supply "in bulk," and another table of the 122 electricity works supplying both lighting and tramways. A large amount of information concerning equipment, system, connections, etc., is given. In an article in the same issue diagrams are given showing the increase of the connections to British electricity stations. An interesting result of the statistics is the large proportion of connections to municipal undertakings in the Provinces, compared with the connections to plants owned by companies, while in London the situation is reversed. The figure for connections to stations which supply both continuous and alternating currents has greatly increased. This is partly accounted for by the number of cases by which additional alternating plant has been installed in stations, formerly generating only direct current, in order to supply outlying districts, and the cases where additional direct-current plant for traction purposes has been installed in stations from which previously only alternating supply was given. The general tendency, however, of grouping together existing direct current networks through sub-stations to large high-tension two-phase and three-phase generating stations, both in London and in the Provinces, is perhaps the largest factor in this direction. Another interesting result of the statistics is the much higher proportion of motor load to lighting load in the case of companies than in the case of municipal stations in the Provinces.—Lond. *Elec.*, January 19.

Direct-Current Testing Room for Central Stations.—JOHNSON.—An article advising central station engineers to equip a special room for making regular tests. As "most meters now in use on consumers' premises tend to read slower as their life increases, the saving effected by these tests would probably account for a large portion of the missing units generally attributed to distribution losses." The author describes the testing room of the Burnley station. The scheme consists mainly of a variable motor-generator or booster and a storage battery. The motor receives current through a high-tension plugged board which is also used for lamp tests, etc. The generator feeds another plugged board, by means of which any standard ammeter and choking resistance can be plugged in circuit with any instrument to be tested or with any cell to be charged. The arrangement is described in detail and illustrated by diagrams. It is thought that the whole capital invested in this testing plant could be recovered in a very short time from the revenue of the testing of large station watt-hour meters.—Lond. *Elec. Rev.*, January 19.

Avoiding the No-Load Loss of Transformers.—BOURGUINON.—An illustrated description of an apparatus of Mariage for automatically connecting and disconnecting several transformers with a network according to the changing load.—*La Revue Elec.*, December 30.

Wires, Wiring and Conduits.

Cable Insulating.—MAYES.—An article pointing out that by far the larger proportion of interruptions of supply of current in electric lighting systems are directly attributable to the developments of faults in the outside distributing mains. The author has had some experience with systems carried out upon the culvert principle with bare conductors supported upon insulators. In such a system it is not always practicable to maintain the continuity of the culvert, for instance when passing over the top of a cellar recourse is usually had to insulated cables carried in cast-iron pipes. Experience has proved that when an earth develops upon such a system, it is located either in one of the runs of iron pipe just mentioned or else in one of the house service wires which are also carried in iron pipes. The inference is that the combination of an insulated cable or wire drawn

into a metal pipe and buried in the soil is very unsatisfactory. The fact is that moisture will make its appearance inside of the iron pipes. The author says that infinitely better results would be obtained by substituting creosoted elm trough for the pipe and filling in solid with a bitumen. The troughing must not be near together, but must be joined by means of oak pins. Several cable insulating systems on the market would give equally good or possibly even better results.—Lond. *Elec. Eng.*, January 5.

Distribution Network.—Prohaska.—The first part of an article describing a method of projecting and estimating the financial prospects of a small distributing network (for instance of a small village) connected by a transmission line to a high-tension system.—*Elek. Anz.*, January 11.

Alternating-Current Networks.—Lichtenstein.—The first part of a theoretical article in which the author proposes to discuss the most fundamental conceptions used in the calculation of alternating-current networks. In the present installment the author discusses especially the proper definition of the self-induction of a single wire.—*Dingler's Polyt. Jour.*, January 20.

Electrophysics and Magnetism.

Constitution of Electron.—Kaufmann.—An account of experiments in which he has repeated his measurements of the mass of the electron at various speeds with greatly increased accuracy, in order to decide, if possible, between the rival theories of Abraham, Lorentz and Bucherer with regard to the structure of the electron. As a source of electrons he used radium, and instead of an electromagnet he used two highly-aged permanent magnets. He photographed the magnetic and electric deflection curves on films cast on plate-glass, and compared them with the curves demanded by the three theories. The final result is stated as follows: The value of e/m for infinite slowness, as derived from cathode-rays experiments, is 1.885×10^7. The curves of deflection of the beta-rays of radium, interpreted according to the theories of Abraham, Lorentz and Bucherer respectively, give 1.823, 1.660 and 1.808×10^7 for the same ratio. The theory of Lorentz, according to which the electron in motion is reduced in the direction of motion, but not laterally is, therefore, least probable. The experiments do not, however, decide between the theory of Abraham, who assumes an absolutely rigid electron, and that of Bucherer, who assumes that the electron in motion becomes a Heaviside ellipsoid with unchanged volume, and thus incompressible. But so far, the figures support Abraham's theory.—Lond. *Elec.*, January 19; from *Sitzungsber. der Akad.*, Berlin, November 16, 1905.

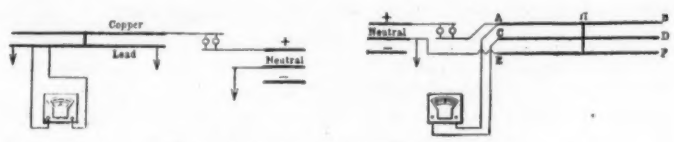
Infra-Red Emission Spectra.—Coblentz.—An account of an investigation of infra-red emission spectra having for its aim the study of the region of the spectrum lighting beyond 2 μ which heretofore had never been examined. Two classes of radiation were investigated, viz.: the arc between metallic electrodes and the chlorides of the alkali metals in the metallic arc and the discharge through a vacuum tube using different vapors and gases. It was found for the arc between metal electrodes that the oxides emitted a black-body spectrum of sufficient intensity to obliterate any emission lines if any were present. Seven different gases were studied in a vacuum tube. Among the same, nitrogen was the only one which has strong emission lines in the infra-red. The changes due to a variation of pressure or current were studied. The emission spectrum of C_2H_5OH shows that the vapor in a vacuum tube can emit continuous spectrum.—*Phys. Rev.*, January.

Frequency in Discharge Tubes.—Reiger.—In the case of non-continuous discharges through gases it is usual to employ a telephone in series with the discharge tube and to consider the sound in the telephone as an indication of the frequency of the discharges in the tube. The author shows that this is wrong, since the period of a discharge may be different in the discharge tube and in the connecting wires. The number of discharges in the same time may be different for different parts of the discharge tube itself.—*Phys. Zeit.*, January.

X-Rays.—Sagnaz. Two papers read before the International Congress for radiology and ionization in Liege. The first paper describes experimental methods for investigating the transformation of X-rays and the resulting secondary rays. The second paper deals with the classification and mechanism of various electric effects due to X-rays.—*Phys. Zeit.*, January 15.

Units, Measurements and Instruments.

Localization of Faults.—Black.—In the second part of his paper on maintenance of underground mains in Glasgow (the first part of which was abstracted in the Digest last week), the author deals with the localization of earths by the loop test. The faulty main is disconnected from the network and the loop made up in the usual way. The slide wire and a millivoltmeter or galvanometer are connected across the loop, and current for the test is provided by connecting the positive outers of the network to the slider of the bridge through a couple of incandescent lamps. Sometimes in opening at the spot indicated at the test, no sign of the fault is seen. It may be only a yard or so away, but there may be nothing for a guide to indicate in which direction to open up further. If the main be lead-covered,



FIGS. 1 AND 2.—LOCATING FAULTS.

Fig. 1 shows the connections for a simple test to indicate this. It is presumed that the lead sheathing is earthed at both ends of the cable. A small bank of lamps taking about 2 amperes is connected to the core of the main at the nearest disconnecting box. The current on getting to the fault will split in two, and travel along the lead to the two ends of the cable. A low reading millivoltmeter connected across, say, 3 ft. of the exposed lead will indicate in which direction the current is passing, and will show the side the fault is on. Short circuits, which are also "earths," may also be found by the loop test, if a loop can be made by some adjoining cable or other means. Owing to cross streets intervening, it is not always possible to stretch a temporary cable along the street, and Fig. 2 shows a test which has been successful in such cases in finding "shorts" in triple-concentric cables. *AB*, *CD* and *EF* are the three conductors in the cable, *EF* being the neutral. *H* is the point of short-circuit. *EF* is coupled up at one end to the general neutral of the system. Two or three incandescent lamps are connected between the nearest positive live main and the positive conductor of bad cable. A millivoltmeter or galvanometer is connected across *AC*, its reading being g^1. The test is repeated at the other end, the lamps being connected to *B* and the reading, g^2, taken across *BD*. The length, *AB*, is known; then $AH = AB \times g^1 \div (g^1 + g^2)$. The author then mentions an interesting device used in Glasgow for indicating the presence of water in manholes on the route of the high-tension mains. A multiple core cable containing a wire for each manhole has been run from the generating station, where there is an indicator board and electric bell. In each manhole is a float, which closes the current when the water rises to a certain height. The corresponding indicator drop falls, and the bell rings, giving warning of the presence of water in the manhole. (In an editorial note this device is called a luxury which will be appreciated when the expense of putting it in is warranted. There is, however, a cheaper alternative, used in Berlin, in which the ordinary low-tension pilot wires have done the duty of the multiple signalling cable in addition to fulfilling their usual function.)—Lond. *Elec.*, January 12.

Automatically Changing Resistance.—Kallman.—In electric stations it is important for testing purposes to have as constant a load as possible on the testing circuit. On the other hand, if the current is taken from the supply network, the voltage in the latter may fluctuate 3 or 5 per cent above or below the normal value. The author has designed the following device for getting a constant power supply for testing. The fundamental idea is the same as is used in connection with the Nernst lamp to protect it against voltage fluctuations of the network by the use of special resistances. These resistances are made from a metal with a very high temperature coefficient, especially iron, so that within certain limits the resistance is changed by the heating effect of

the current in such a way that the current is maintained automatically constant in spite of the fluctuations of the voltage. These resistances are made of very fine iron wire enclosed in spiral form in glass globes in an atmosphere of hydrogen. A certain number of such resistances are used in parallel, and the whole set is connected in series with a resistance of zero temperature-coefficient, made for instance of constantan. At the terminals of this resistance the voltage will be constant, while the current in the same resistance is also constant, so that the same is the case for the power. Results of practical tests show that arrangements based on this principle do all that is needed in practice. The article is fully illustrated.—*Elek. Zeit.*, January 18.

Thermo-Galvanometer.—An illustrated description of the Duddell thermo-galvanometer for measuring alternating currents of small magnitude, in cases where the high resistance of electromagnetic instruments is an objection, and where a sufficient potential difference does not exist to render an electrostatic instrument suitable. Duddell's instrument has practically no self-induction, and can be used to measure currents down to 20 micro-amperes at frequencies up to about 120,000 periods per second. Another important advantage of the instrument is that it can be accurately standardized by continuous current and used without error on circuits of any frequency or wave form. At the same time, it is very dead beat, and is unaffected by magnetic fields. The apparatus is shown diagrammatically in Fig. 3. In the field between the pole pieces, *N S*, of a permanent magnet is suspended by means of a quartz fibre, *Q*, a single-turn coil or loop of wire, *L*, to the lower ends of which is fixed a thermo-couple. This loop is surmounted by a glass stem, *G*, which carries a mirror, *M*. Beneath the lower junction of the thermo-couple is fixed the heating resistance or "heater," one end of which is connected to the frame of the instrument to avoid electrostatic forces. The current to be measured passes through the "heater," raising its temperature, causing the lower junction of the thermo-couple to rise in temperature above the upper, thus producing a current round the loop, *L*, which is deflected by the magneto field against the torsion of the quartz fibre, *Q*. The deflections of the instrument are practically proportional to the square of the current when the heater is central under the junction. The sensibility of the instrument depends on the resistance of the "heater," and on its distance from the thermo-junction. The "heaters," are set up in small protecting cases with contact rings, so that they can be interchanged quickly when it is desired to greatly alter the sensibility of the instrument. An adjusting screw is provided so that the distance between the "heater" and thermo-junction can be varied, and by this means small changes in the sensibility can be made without altering the "heater" or changing the shunts in use for the experiment. Shunts may be used with the instruments for measuring low-frequency (under 1,000 periods) and continuous currents, but for high-frequency currents, such as those employed in wireless telegraphy, there is great uncertainty as to the ratio in which the current will divide between the instrument and shunt circuits. In actual use, the thermo-couple is protected by a heavy metal plate, and a cover is used to protect the instrument from dust and radiation. The mirror, *M*, is plane, but the instrument is used in conjunction with a lens, which gives an image on a scale at a distance of 1,000 cm, when used with the ordinary lamp and scale. A number of different heaters can be used, varying in resistance from 1 to 1,000 ohms, so that the sensibility of the instrument can be varied from 22 micro-amperes per 10-mm. deflection to 2,000 micro-amperes per 10-mm. deflection. The heaters from 40 ohms downward are metal wires, those above 40 ohms consisting of a deposit of platinum on quartz. The instrument can be used for measuring the currents in the receiving aerial in wireless telegraphy, for telephone currents, for the currents used in X-ray tubes and medical induction coils, and a variety of similar purposes.—Lond. *Elec.*, January 19.

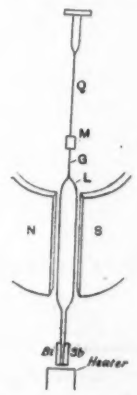


FIG. 3.—THERMO GALVANOMETER.

Induction Watt-Hour Meters.—ROSA, LLOYD AND REID.—A preliminary account of a long series of experiments on the influence of wave form on the reading of induction watt-hour meters. The results show that with suitable precautions induction meters may be made to repeat their readings very accurately, so that precision methods may be applied in studying them. The variations due to wave form depend not only on the harmonics which are present and their magnitude, but also on their phases. For commercial purposes all the meters so far studied may be considered accurate on any ordinary wave form where only the third harmonic enters appreciably, although two meters show variations of about three per cent when the harmonic amounts to as much as 50 per cent of the fundamental.—*Bull. Bureau of Standards*, No. 3.

Miscellaneous.

Electric Clocks.—An illustrated description of several electric clocks devised by Sallin.—*L'Elec.*, January 6.

Surveying Deep Bore Holes.—PORTER.—An illustrated description of a new instrument for surveying deep bore holes. It contains a compass, plummet, small cameras, and electric light, the whole connected with a small adjustable clock, so that the light may be turned on for a given period after the apparatus has been lowered into the hole. It has been used in surveying a number of holes in South Africa and has proven very satisfactory. Both dip and deviation are recorded by means of photographs of the positions of both a plumb-bob and a magnetic needle at any desired point in the bore hole. The photographs are taken by means of two small electric lamps lighted by a time contact. —Lond. *Elec. Rev.*, January 19.

Export of General Electric Apparatus.

A group of recent orders taken by the General Electric Company, through its foreign department is interesting as illustrating the part taken by the electrical interests of the United States in the foreign markets of the world. The variety of uses for which this electrical apparatus is intended is also significant.

From Australia, through the Australian General Electric Company, an order for Wellington, New Zealand, calls for a Curtis steam turbine generator of 500 kw capacity for use in furnishing electric light and power.

Japan furnishes orders through Bagnall & Hilles for the electrical equipment of a large coal mine, including a generator of 180 kw output, to furnish power for a number of induction motors aggregating 200 hp. In addition other Japanese orders for induction motors amount to 575 hp in sizes from 20 to 50 hp.

South American orders include electric railway apparatus for the Bahia Tramways, Bahia, Brazil, through Guinle & Co., of Rio de Janeiro, consisting of three motor-generator sets of 300 hp each and three sets of 225 hp each, with necessary switchboard and electric car equipments for 36 cars of a total capacity of 80 hp each.

For a lighting plant at Lincoln, Argentine Republic is included a gas engine-driven 130-kw generator ordered through the South American General Electric Supply Company, Buenos Ayres. For Lima, Peru, one order includes 16 two-motor equipments of 80 hp each for electric cars.

For use in Africa the South African General Electric Company, Johannesburg, has ordered nearly 100 induction motors of an aggregate capacity of 2,175 hp. One order from India consists of four water wheel-driven 1,000-kw electric generators, and two of 150 kw each; six 60,000-volt transformers, each of 1,000 kw capacity, in addition to line material, such as wires, insulators, lightning arresters, etc., for a 65-mile transmission system and a complete outfit for 2,000 kw of sub-station equipment. This is for the Jhelum River Power Installation at Kashmir, India.

For the Prussian Government Railways of Germany there are being constructed six Sprague-General Electric control equipments each for two 125-hp motors and thirty Tirrel voltage regulators. The Metropolitan Railways, London, England, has ordered through the British Thomson-Houston Company, electric

car equipments for twenty cars, each consisting of four 200-hp motors and Sprague-General Electric Type M control system and for forty trailer cars. The French Thomson-Houston Company has ordered three 1,000-kw Curtis steam turbine generators for installation at Marseilles, France.

The foreign markets nearer home have been equally active, is is shown by the following orders, which are typical of this part of the General Electric Company's foreign business. The Canadian General Electric Company has ordered a 500-kw Curtis steam turbine generator for the Winnipeg Electric Railway in Manitoba. From Mexico through the Mexican General Electric Company, orders have been received for apparatus consisting of two 300-kw generators complete with exciters and generating station equipment for the Cananea Consolidated Copper Company, Sonora, Mexico; for the Winas Tecololes y Aneas, Chihuahua, Mexico, a lot of induction motors totaling 1,000 hp and two mining locomotives; for Negociacion Minera de Guadeloupe, Mazatlam, Mexico, two 200-kw generators with exciters and switchboard and 19 induction motors aggregating 400 hp; for Mexico Electric Tramways, Mexico City, four two-motor, 40-hp railway equipments.

The Cooper-Hewitt Single-Phase Converter.

Historically speaking the Cooper-Hewitt converter is a result of the development of the Cooper-Hewitt lamp. The devices made by Arons and others, which antedated that of Mr. Hewitt, were not capable of continuous operation as lamps. They served merely to study certain aspects of the physical phenomena involved in this novel apparatus. Mr. Hewitt showed that in order to get an operative lamp it is necessary to provide an adjustment of the cooling surface to the quantity of heat generated, which result is accomplished by providing a chamber out of the path of the current in which there might be a dissipation of heat

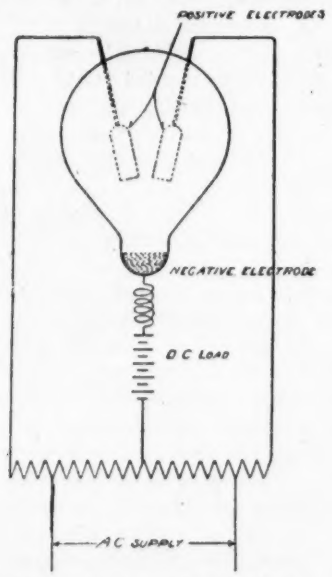


FIG. I.—DIAGRAM OF CIRCUITS.

without a corresponding development of heat. Increasing the length of the tube of a lamp does not serve the same purpose as this condensing chamber, since with the increase of length there is also an increase of heat generated. In the six or more years, during which time Mr. Hewitt has been giving attention to these phenomena, he has developed a practical lamp well adapted to general use, which has become an important factor in commercial electric lighting. Mr. Hewitt has further made extensive investigations as to the general character of the phenomena of his apparatus, and has determined many of the laws governing them. Much of these data has been given to the public in various publications. Several important patents, covering a portion of his work, were issued on September 17, 1901, applications having been filed April 5, 1900, and January 25, 1901.

An indication of the nature of the investigations was first publicly given by Mr. Hewitt before the American Institute of Electrical Engineers on April 12, 1901, at which time mercury-vapor lamps of various sizes and shapes were shown in successful operation, and their high efficiency demonstrated. On this occasion it was explained that in a tube of uniform section the resistance varies inversely with the current, the volts tending to remain constant; and that the proper voltage for the lamps varied directly as the length and inversely as the diameter of the tube. It was shown that the resistance of the vapor in the lamp can be made to vary in a predetermined manner within wide limits by varying the proportion of the vapor subjected to the current and the heat-radiating capacity of the lamp.

The peculiarity exhibited by the vapor apparatus in respect to initial reluctance to the establishment of current, which is the most striking characteristic of the apparatus, was the subject of systematic experimental investigation undertaken at an early stage of the work. On January 3, 1902, Mr. Hewitt presented before the American Institute of Electrical Engineers a paper in which the difficulty in causing the first rush of current was attributed to a negative electrode resistance which must be overcome before an appreciable value of current can be caused to flow through the vapor. The fact that the lamp was not directly operative by alternating current was attributed to the existence of this negative electrode resistance, which has an inappreciable value so long as the current flows but immediately increases enormously when the current ceases.

The Cooper-Hewitt vapor-converter, with which this article primarily treats, was, as stated, the direct outcome of the Cooper-Hewitt lamp. Although the character of the circuits and the function performed by the converter differ in many respects from those of the lamp, nevertheless, as regards the degree of vacuum required, the use of a mercury negative electrode, the general character of the positive electrodes and other features, the two types of apparatus are similar. In the lamp the reluctance to starting was in some respects an obstacle; in the converter the whole function depends upon this resistance, and the invention of the converter was an extremely ingenious means of rendering useful this troublesome characteristic of the lamp.

Although the operation of the converter depends upon the perfection of the negative electrode resistance of the positive electrodes, no current at all can be passed until the electrode resistance of the negative of the converter is overcome. This result may, of course, be accomplished by any of the methods used in the mercury-vapor lamp. For a short time the lack of automatic means of accomplishing this purpose economically at each alternation, as would at first glance appear to be necessary, retarded the development of a practical type of apparatus. Mr. Hewitt soon realized, however, that the use of a three-phase, or other polyphase supply of electromotive force connected to three positive electrodes would return current from the negative of the converter to the neutral point of the supply and when once the apparatus was started it would operate continuously, since at no instant would there fail to be an e.m.f. in the right direction upon at least one of the positive electrodes.

The announcement of the polyphase converter was made in these columns on January 17, 1903, at which time the characteristics of the device were discussed in detail. In the polyphase converter there is never any interruption of current at the negative electrode, and, therefore, no trouble is experienced in keeping the converter in continuous operation. In a simple single-phase converter, however, the current would be interrupted at the end of the first alternation, whereupon the negative electrode resistance would assert itself.

The first announcement of a commercial single-phase converter was made at the Niagara meeting of the American Institute of Electrical Engineers in June, 1903. In this converter two modifications of the simplest form of single-phase circuit are sufficient to cause continuous operation. Two positive electrodes are provided, connected to the terminals of a transformer winding whose middle point is connected to the negative electrode of the converter, thus furnishing substantially two single-phase e.m.f's oppositely directed, connected respectively to the two positives. A choke coil is connected in the negative lead, the result of which is to delay the decreasing current from one positive electrode, until the increasing current in the other is sufficient to

maintain the converter alive. Although the details of the converter shown at Niagara have been somewhat changed, its general operating features have been retained in the present commercial type. It is with the constructional features and operating characteristics of the device as now used that the present article deals more particularly.

This outfit is primarily a battery charging outfit, and as such must work against a counter e.m.f., and must be provided with means for adjusting the strength of the current. This latter function is accomplished by means of adjustable inductance placed in the supply circuit. An auto-transformer is used for adjusting the voltage of the supply to that required for the particular battery to be charged, at the same time providing the neutral point for connection to the negative electrode through the battery. The choke coil placed in the negative, which is called the "sustaining coil," is located as shown in Fig. 1. By referring to Fig. 1 it will be easy to trace the course of the currents in the auto-transformer. Assume for this purpose, that this auto-transformer is replaced by a separate primary and

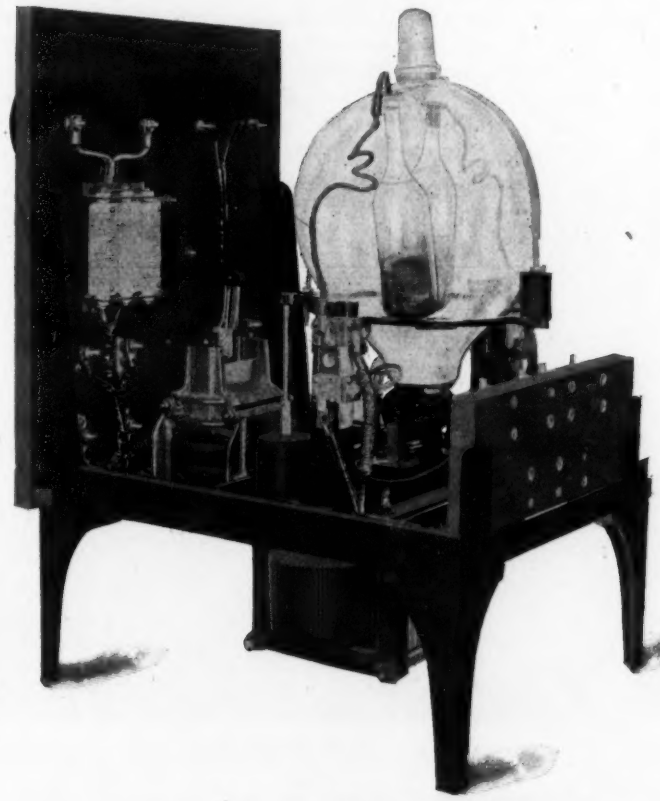


FIG. 2.—VIEW SHOWING DETAILS OF CONVERTER.

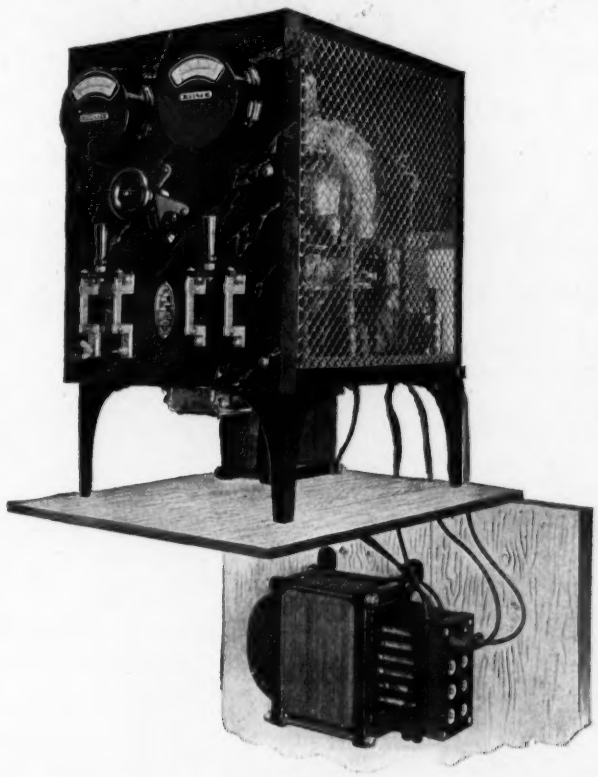


FIG. 3.—FRONT VIEW OF CONVERTER EQUIPMENT.

secondary, the secondary winding having the same voltage as the auto-transformer shown. Evidently during all the positive alternations one-half of the secondary will be passing current through one positive electrode, the converter itself, the sustaining coil, storage battery, and back to the neutral point of the secondary winding; and during all negative alternations the other positive will supply current through the converter itself, the sustaining coil, storage battery and back to the neutral point of the secondary. The current in either half of the secondary, since this is a transformer, will be balanced by current from the supply in the primary winding. It will be noticed that both halves of the secondary have the same primary, so that though current is intermittent in any part of the secondary winding, there is practically an alternating current in the primary. Assuming that the transformer is changed to an auto-transformer, the current in any portion of the winding will be the vectorial sum of the currents flowing in primary and secondary, as already described. From this it will be seen that no portion of the auto-transformer is traversed by intermittent currents, provided the supply voltage is that across the positive electrodes.

The efficiency curve of a mercury vapor converter has unusual characteristics, since the energy loss in the converter is proportional to the current and not to the square of the current; that is, regardless of the value of the current, the converter consumes a constant e.m.f. of about 15 volts across itself. The efficiency will remain constant for all loads, except for the effect of the heat losses in the auto-transformer, the sustaining coil, the regulator and other incidental apparatus. This is an important feature of an apparatus which is often used at less than full load. It is evident, further, that the higher the direct voltage of the battery, the higher the efficiency of the apparatus. It is found that including the auto-transformer, inductance coil, etc., the efficiency of this commercial type of vapor converter when delivering direct-current at 115 volts, is about 80 per cent.

Views of the converter in its present form are shown in Figs. 2 and 3. The bulb is supported in a circular framework which is mounted upon trunnions allowing the bulb to be tilted when desired. The object of tilting the bulb is to cause the mercury from an auxiliary positive electrode to come into contact with that of the negative electrode and thus to start an arc which will destroy the initial electrode resistance at the negative, thereby allowing the main positive electrodes to come into operation alternately. The tilting is accomplished automatically by an electromagnet which comes into play immediately when the switches are closed. A cut-out device operated by the main current of the converter serves for interrupting the circuits to the tilting magnet and to the supplementary electrode, when the bulb is in normal operation.

For the purpose of controlling the strength of the current there is used a reactance coil, the inductance of which is variable at will by means of a handle which serves to change the position of the magnetic core within the coil as desired. By this means it is possible to get a continuous adjustment of current throughout the range of the apparatus even with a wide variation of battery and supply voltage.

It is worthy of note that, when the converter is used for supplying current to storage batteries, it is impossible for the batteries to discharge back through the converter, due to the fact that the positives electrodes cannot become negative on account of the presence of the initial negative electrode resistance. When the alternating voltage decreases below a certain value, or fails entirely, the converter ceases to operate, but it starts again automatically when the voltage return to its normal value.

A Self-Exciting Alternator.

Our issue for last week contained an account of the theory upon which depends the operation of the self-exciting alternator devised by Mr. E. F. Alexanderson and described by him before the recent meeting of the American Institute of Electrical Engineers. We give below a discussion of the practical features embodied in the construction of this interesting type of machine.

The revolving field of a 100-kw alternator with its segmental rectifying commutator is shown in Fig. 1. The field poles and

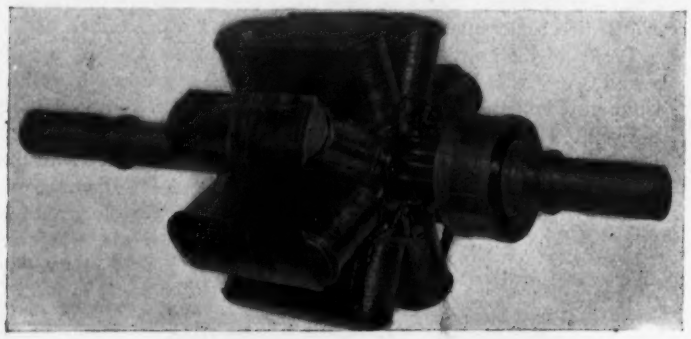


FIG. 1.—REVOLVING FIELD OF 100-KW, SELF-EXCITING ALTERNATOR.

their windings differ in no respect from what are used with any ordinary type of alternating-current generator. The commutator is built on a straight shell, and the segments are held together by two steel rings shrunk on the ends of the bars. These rings serve as an electrical connection between the different segments, one of the rings being connected to every other segment, and the other ring to the rest of the segments. The two terminals of the field winding are connected to two segments of opposite polarity, and consequently to the respective end rings. In this way the end rings can be used at any time as collector rings for separate excitation. The spaces between the segments are electrically equivalent to air-gaps, but in order to support the brush mechanically the dead spaces are filled with a number of small copper bars separated by mica insulation.

The current which passes through the commutator to the field winding is derived from a special exciting winding placed in the same slots with the main armature winding. The exciting winding is of the three-phase type and is connected in "star," the neutral point of which is formed by a three-part rheostat. Thus in series with each coil of the exciting winding is connected a certain resistance the effective value of which is varied automatically according to the load. Each section of this rheostat is in effect connected in circuit also with one coil of a three-phase series transformer, the primary of which carries the load current.

The circuits as joined to one section of the rheostat are indicated in Fig. 2. The series transformer sends a current through

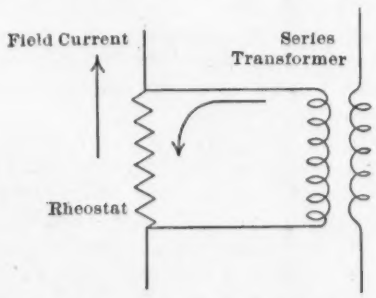


FIG. 2.—CIRCUITS OF COMPENSATING RHEOSTAT.

the rheostat in a direction more or less opposite to the field current, thereby eliminating the proper proportion of the voltage drop in the rheostat. The elimination of the voltage drop in the rheostat changes over more or less of the field current from the rheostat to the series transformer. The secondary current of the series transformer is in phase with the line current, while the field current is practically in phase with the voltage. The amount of boosting in the field current will, therefore, depend not only upon the value of the secondary current, but also upon the power factor of the load. A function of the rheostat which is just as important as the field control is its influence on the commutation, as explained in our last issue. As far as commutation is concerned, the full resistance of the rheostat may be considered as always being in circuit, although the larger part of the field current may flow through the series transformer.

The commutation consists in changing over the direct current from one phase of the exciting circuits to another, and should occur a little later than at the moment in which the induced voltages are equal in the two phases undergoing commutation. The moment of commutation should be delayed to such an extent that the difference in voltage between the two phases begins to force through the completed circuit formed by the two phases and the rheostat a cross current, which is superimposed on the field current, and will weaken the current in one of the phases and strengthen it in the other phases, so that one of the phases will carry the entire current and none will pass through the brush which is leaving the segment.

It is stated that these machines have shown favorable results in parallel operation with ordinary machines, and also with other self-exciting alternators. The machines can also be used as synchronous motors. A self-exciting synchronous motor can be either shunt connected or compounded. Compounded synchronous motors will be found to be especially useful for boosting the voltage at the ends of long transmission lines. In this case the

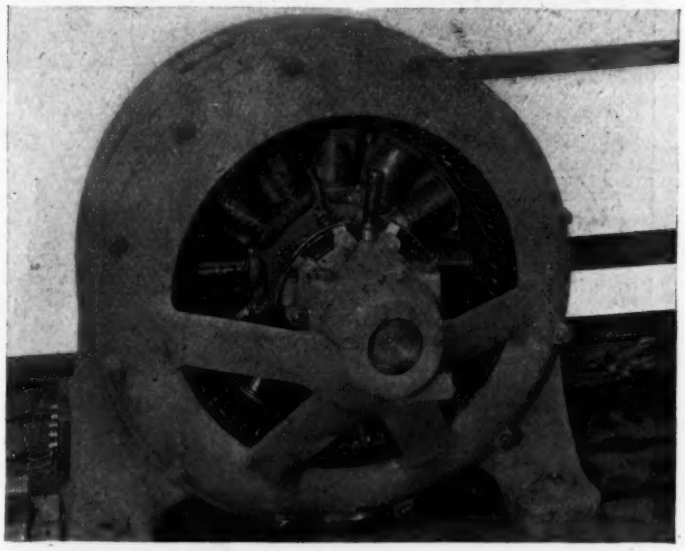


FIG. 3.—200-KW, SELF-EXCITING ALTERNATOR.

series transformer which is used for compounding is connected in series with the main line, so that an increase of current in the rest of the system raises the excitation, with a consequent increase of leading current in the synchronous motor.

The method of starting a self-exciting synchronous motor is the same as that of starting an ordinary synchronous motor until the speed approaches synchronism. The ordinary synchronous motor is an induction motor brought up to an approximately synchronous speed through the inductive relation of stator and rotor windings. When the field is excited the revolving part receives alternately positive and negative impulses as the poles slip over the synchronous positions, until one positive impulse is strong enough to pull the machine into step. In synchronizing the self-excited synchronous motor, the same phenomena will occur as in the self-excited generators. When the torque due to inductive effect begins to decrease on account of the decrease of slip the excitation impressed through the commutator becomes active, and the field will receive a series of impulses—all in the same direction—which increase in strength with the decrease of slip until synchronism has been reached.

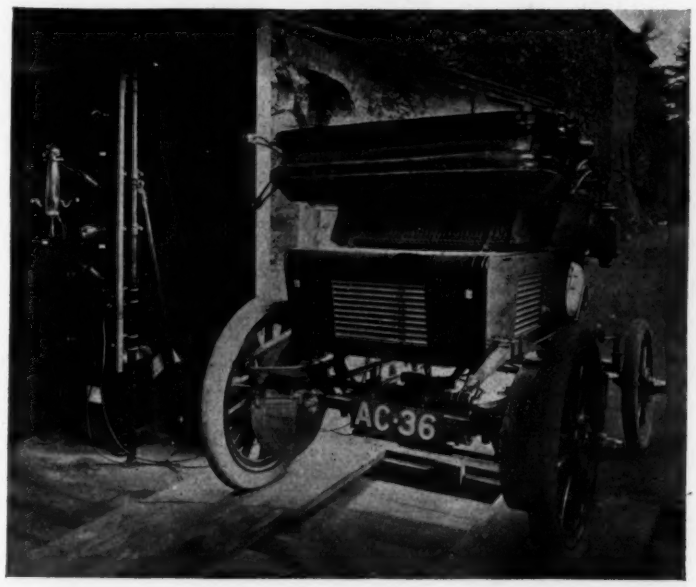
The fact that the machines described have passed the experimental stage, and that one of the leading electric concerns is manufacturing them as standard apparatus, gives promise that more data regarding the practical and commercial operation will soon be available.

Automobile Mercury-Arc Rectifier Set.

The accompanying illustration shows a mercury-arc rectifier set installed by the British Thomson-Houston Company installed for charging automobile storage batteries from alternating-current supply mains. The principal parts are the panel, tube and holder, and compensatory reactance.

The panel is of slate, 4 ft. x 2 ft. x 1½ in. with ⅜-in. bevel, mounted on 1-in. supporting pipes. It contains a voltmeter, ammeter, double-pole switches for connecting to battery and alternating-current mains, and the necessary double-pole and single-pole switches for starting and operating the rectifier. Fuses and circuit breaker are supplied for protecting the rectifier against heavy overloads. A starting resistance is mounted on one of the pipe supports, and is connected in multiple with a pilot lamp mounted on the front of the board. The starting resistance is used to start the rectifier before the load is thrown on. The pilot lamp connected in shunt across the starting resistance remains lighted until the load is substituted for the starting resistance.

The mercury vapor tube has two anodes, one cathode and one starting anode, and is provided with metal caps for the terminals, which protect the electrodes, thus reducing to a minimum the liability to breakage and burn-out. The leads from the



AUTOMOBILE-CHARGING OUTFIT.

anodes are connected to a compensating reactance, while the lead from the cathode forms the positive side of the direct-current circuit. The holder consists of a moving member mounted on the face of the panel and provided with spring clips for holding the tube. Terminals for connecting the various parts of the tube to the panel are mounted on the panel.

The compensating reactance is connected directly across the alternating-current supply mains and is either mounted on the back of the panel or placed on the floor under the panel. Leads are brought out from the reactance to a dial switch mounted on the front of the panel. By means of this switch the voltage and current may be varied within the limits of the rectifier. A tap is brought out from the center of the reactance and forms the negative side of the continuous current circuit.

The complete outfit occupies a floor space of approximately 24x18 in., and is 76 in. high. This type of rectifier is designed for operation on either 110 or 220-volt, 50-cycle, alternating-current circuits. It has been found that for batteries requiring a range of voltage from 45 to 115 volts continuous current, approximately 220 volts alternating current will give the best results, while for smaller batteries requiring a range from 16 to 45 volts continuous current, approximately 110 volts alternating current is most satisfactory. The direct-current voltage may be said to range from approximately 20 to 55 per cent of the applied alternating supply, according to the connections used; while the alternating current, under similar conditions, is from 40 to 65 per cent of the delivered direct current. The outfits operate satisfactorily on any frequency from 25 to 150 cycles. The efficiency of the mercury arc rectifier, on account of a constant loss of approximately 15 volts in the arc, depends largely on the direct-current voltage used. Thus, although the efficiency is only about 60 per cent at 30 volts output, it is 80 per cent at 115 volts. The shape of the efficiency curve differs from that of the motor-generator set in this important particular, namely, that the efficiency at partial loads is as high as the full load efficiency. The same is true of the power-factor, which is extremely high for a converting apparatus of this capacity and seldom falls below 90 per cent, and often considerably exceeds this value.

Where it is desired to charge at a higher rate than 30 amperes, it has been found that two or more rectifiers can be operated in multiple very satisfactorily. The standard panels are readily adaptable for multiple operation by a few slight changes.

High-Pressure Blower.

An interesting form of high-pressure air blower is shown in the accompanying illustration. The blower consists of a cast-iron shell or housing in which are two rotating members or "rotors." One of these, the impeller, which revolves in the larger portion of the casing, does the real work of compression. The other rotor, known as the idler, does no work. It successively provides

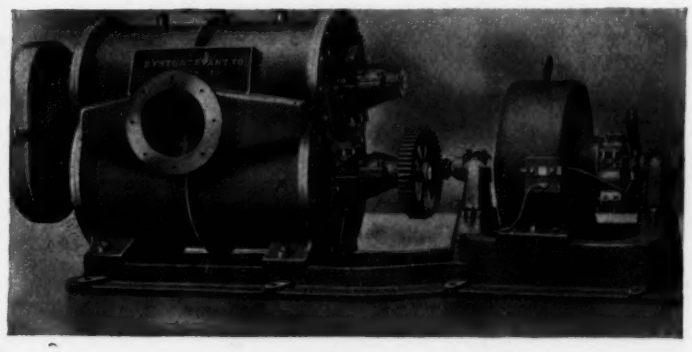


FIG. 1.—HIGH-PRESSURE BLOWER.

spaces or chambers of proper shape at the desired points in the revolution, so that the impeller blades may return to the suction side of the blower without allowing the escape of compressed air.

The idler or drum, revolving in the smaller part of the casing, is symmetrical and has a periphery nearly a complete circle. It consists of three hollow vanes or blades cast in one piece with the shaft, and is turned at the same speed as the impeller by means of two spur gears running in oil and encased for protection against dirt and accident.

The impeller, mounted on the driving shaft, is made up of three

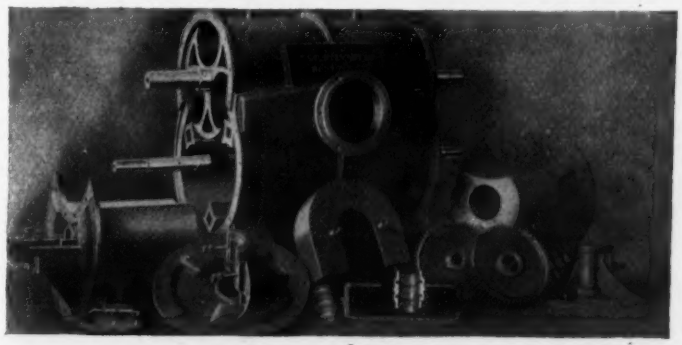
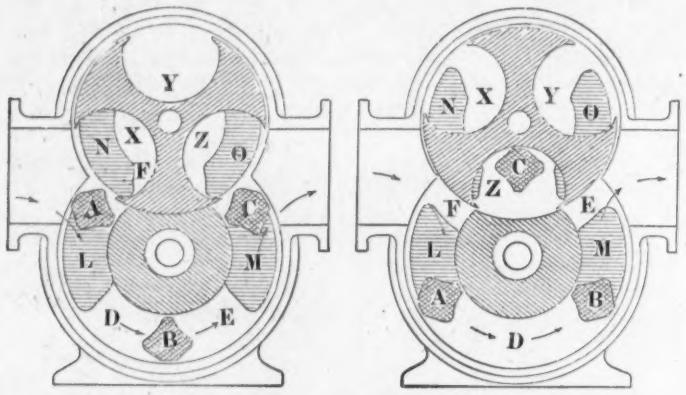


FIG. 2.—PARTS OF BLOWER.

diamond-shaped bars or blades and a central web which is keyed to the steel shaft. As it revolves three separate pockets are formed in the annular space between the shell and a core extended lengthwise of the lower part of the casing.

Air at atmosphere pressure entering the blower at the intake is successively imprisoned in the three pockets formed by the three blades of the revolving impeller and discharged at any desired pressure up to ten pounds per square inch. The volume of free air delivered varies directly with the number of revolu-



FIGS. 3 AND 4.—CROSS-SECTION VIEWS OF BLOWER IN OPERATION.

tions, while the pressure varies with the resistance met in the delivery pipe.

The principle upon which the blower operates is clearly shown by sectional views of Figs. 3 and 4. This blower is manufactured by the B. F. Sturtevant Company, Hyde Park, Mass.

Crocker-Wheeler Annual Convention.

The annual meeting of the heads of departments and of branch offices of the Crocker-Wheeler Company was held recently at Ampere, N. J., when there was a large gathering from all parts of the country. The business proceedings were conducted at the Ampere factories, and on January 25, the gentlemen in attendance were guests of Dr. S. S. Wheeler, president of the company, at dinner, at the University Club, New York City.

The record of the year's business as shown by the annual reports of the branch managers of the Crocker-Wheeler Company indicates not only an increase over the business of 1904, but an increase over that of the year 1903, which was up to that time the record year of the company. The progress of the company has been marked in the alternating-current field, and it has also maintained its enviable place in the direct-current field. During the past year the company has developed a line of core-type transformers the first publication in regard to which appeared in the Electrical World of January 6, and which has been commercially introduced with signal success. The prospects for a very greatly increased business during 1906 were considered bright by all the branch managers present. Great satisfaction was expressed with the line of transformers, and much is expected from two other new lines of electrical machinery that the company is about to put on the market.

Among those present were F. W. Kreps, W. C. Appleton, H. M. Gassman, H. Fuller, B. A. Schroder, S. Russell, Jr., C. W. Startsman, J. R. Wilson, H. A. Brown, H. J. Sage, H. C. Petty, H. C. Baker, Harold Lomas, R. N. C. Barnes, H. B. Hussey, Julian Roe, L. M. Ward, Rodman Gilder, C. N. Wheeler, M. E. Weissblatt, J. S. Horner, E. Heitmann, A. Hartmann, W. F. Sullivan, H. Pikler, J. B. Milliken, H. L. Patterson, W. L. Brownell, A. L. Doremus, S. S. Wheeler, G. S. Dunn, W. A. Doble, F. B. De Gress and G. W. Bower.

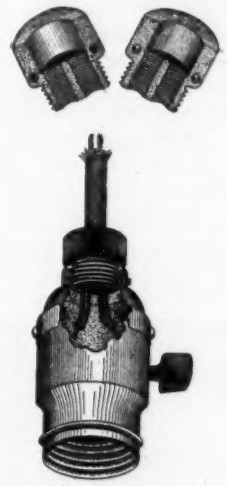
High-Speed Corliss Engines.

The Hooven, Owens, Rentschler Company, Hamilton, Ohio, has recently placed upon the market a type of Corliss valve engine especially designed for direct connection with electric generators. This type of engine is made from the regular Corliss patterns with the exception that the strokes are shorter, the dashpots are eliminated, the valve gear is directly driven and the governor is of the inertia type located in the fly-wheel.

The range of speed for this type of engine will be from 125 to 200 r.p.m. These engines will be made in all sizes from 50 hp up in the single-cylinder, tandem and cross-compound types of both the horizontal and vertical styles.

Strain Bushings for Sockets.

The Frank H. Stewart Electric Co., 35 N. 7th Street, Philadelphia, is placing on the market a new device known as "Knostrain" bushings, designed to take the strain off electrical connections in ⅜-in. sockets and ceiling rosettes. The latter type can also be used as a handle bushing. The bushings are made



STRAIN BUSHINGS.

in two pieces with corrugated grooves so arranged that they firmly grip ordinary lamp and show window cord and act as an insulator at the same time. The underwriters naturally favor the use of a device that overcomes the knotting of cords as now practiced. The apparatus as applied to sockets is here shown complete and in section.

Soldering Flux Tube.

The Climax Manufacturing Company, Boston, is placing on the market a soldering paste contained in a collapsible tube pro-

METHOD OF USING FLUX TUBE.

vided with a stiff aluminum spout. The outfit can thus be carried in a pocket like a screw driver, and the aluminum spout allows the paste to be applied directly to the joint at the same time as the solder, as illustrated in the accompanying cut.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Retailers have become reconciled to the mild winter weather and are now giving more attention to spring trade, in which there is a decided activity. The absence of severe and sudden weather changes has been beneficial so far to the winter wheat crop, which does not show any ill effects from the lack of snow covering. General industry is favored by the weather conditions, but the demand for anthracite coal is slack, and bituminous is lower in price. Collections are reported irregular, and money is easy. There is great activity in building operations due to the continued mild weather, and this despite record prices for building material. Lumber, paints and hardware are generally active. Lack of cars and vessel room checks Southern shipments. In the iron and steel markets there is a heavy demand for structural shapes and for steel rails, sales of the latter during the week amounting to 80,000 tons and for the month of January over 250,000 tons. Official figures show that 22,992,380 tons of pig iron were produced in 1905, 6,493,347 more than in 1904. The increase in 10 years was 166 per cent. The domestic market for electrolytic and lake copper of the best brands is firm at 18⅝c. Large producers who dispose of more than a third of America's products of electrolytic slabs and bars give it as their opinion that 18⅞c. will be the ruling price for months to come. Casting copper in small lots is reaching the hands of metal dealers. It is quoted at 18½c to 18⅝c. It turns out that the amount of copper coming back from China has been greatly exaggerated by the London bears at the London Metal Exchange. Consumption goes right along at a quick pace, and manufacturers continue to receive orders for their finished product to an extent which indicates a bright and healthy situation. Copper for electrical equipment will undoubtedly be in greater demand as the rapid development of new projects in this field will require plentiful supplies of the metal. Electric power of all descriptions is being substituted for old methods and being introduced on a scale suggestive of heavier requirements of copper for electrical purposes. Boston advices state that the copper market is dull, but the metal situation has not lost one whit of its strength. Lake and elecrolytic are held at 18¼ to 18¾ cents by all the important producing interests. Almost no sales are being made, either at these or lower prices. Fully 80 per cent of all the copper that can reach market in February, March and April has been sold. It is believed that the remaining 20 per cent will be sold before it is ready for delivery. There is no sign of any decrease in consumption. *Bradstreet's* reports 228 business failures during the week ending February 1, against 276 the week previous and 239 in the corresponding week last year. January returns show more failures and larger liabilities than a year ago. There were 1,213 suspensions, involving $15,360,188, an increase of 1 per cent in number over last year, and of 38 per cent in failure damage. Compared with January, 1904, the number shows an increase of 8 per cent, but the liabilities are 10 per cent smaller.

APPARATUS FOR ATHENS TROLLEYS.—United States Consul Horton, of Athens, reports on the electric tramway extension for Athens and Piræus, to be developed from the present horse and steam system by Franco-Belgian capitalists. Delay was caused in granting the new concession because of the change in the Greek ministry, all such matters having to be ratified by the Chamber of Deputies. The present 25-mile line will be transformed into a 30-mile electric line, with 60 per cent of it double-tracked. The electrical apparatus will be manufactured in Paris by the Thomson-Houston Company. Further information can be secured from G. S. Albanese, care the Greek Electric Company.

TELEPHONY FOR RAILROADS.—The International Telephone Manufacturing Company, of Chicago, has recently furnished for the St. Louis & Springfield Railway Company and the Illinois Traction Company, an up-to-date modern switchboard equipment, specially arranged for despatching service for their joint offices at Staunton, Ill. This board is of the desk type with special top cabinet and is so constructed as to enable the attendant to supervise carefully the despatching of trains over the various lines. The International Company, during the past year, has made quite a specialty of furnishing this class of apparatus for interurban lines.

NAVY SUPPLIES.—Bids will be received until February 13 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards at Portsmouth, N. H., Boston, Mass., Newport, R. I., New York, N. Y., League Island, Pa., Washington, D. C., and Norfolk, Va., a quantity of naval supplies as follows: Schedule 344, drum controllers, arc lamps, etc., electrical supplies, etc.; schedule 345, rheostats, contact makers, etc.; schedule 346, motor, incandescent lamps, etc. Applications for proposals should designate the schedules desired by number. H. O. B. Harris, Paymaster-General, U. S. N.

ALLIS-CHALMERS MOTORS FOR COAL FIELDS.—We note the installation of a new Allis-Chalmers electrical power plant equipment for the McKell Coal & Coke Company, of Glen Jean, W. Va., at its properties at Kilsyth, West Va. The new equipment will consist of a 26-in. by 42-in. heavy duty Allis-Chalmers engine and generator unit, 500 kw, 25 cycles, with switchboard, lightning arrester, rotary converter and transformer equipment complete. The Allis-Chalmers Company will superintend the erection of the plant at Kilsyth and the sub-stations which are expected to be ready for operation in April.

ALLIS-CHALMERS SALES.—Recent sales of Allis-Chalmers electrical apparatus to prominent Wisconsin firms include a generator to the Creamery Package Company, Lake Mills, Wis.; a generator with switchboard, etc., to the Badger Brass Company, Kenosha, Wis., and generators to F. Hamill, et al., Spooner, Wis. The Buffalo office of the Allis-Chalmers Company reports the recent sale of a 100-kw type "I" generator to the Magnus Beck Brewing Company, Buffalo, and two 100-kw, type "I" generators to the Robertson Electrical Construction Company, also of Buffalo.

THE ALLIS-CHALMERS-BULLOCK, LTD., Montreal, the Canadian representative of the American Company, received recently an order from the Canadian Forty-Mile Gold Dredging Company, of Toronto, Can., for a special gold dredge equipped complete with 5⅓ cu. ft. buckets. The contract covers the entire machinery equipment complete, ready for operation, including electric light plant, two boilers, 100 hp each, engines, pumps, etc. The dredge will be ready for use early in May.

APPARATUS FOR GROTON, CONN.—The borough of Groton, Conn., has recently installed a municipal plant from the Crocker-Wheeler Company, of Ampere, N. J., as follows: One 165 K.V.A. engine type alternator and 13 kw belted exciter, the switchboard and an induction motor of its own manufacture; the whole to be set up before May 1. The current generated will be used in lighting the town of Groton and vicinity, and for driving the municipal water works pumps.

THE ROBINS CONVEYING BELT COMPANY, of New York, has recently secured an order from the Imperial Japanese navy for a 12-inch belt conveyor for its arsenal at Tokio. Among other orders the Robins Company now has on hand is one from the Solvay Process Company, of Syracuse, for conveyors for its stone crushing plants, and one from its agents in South Africa for a conveyor for use in tailing stacker in one of the large gold mines in the Rand.

SHIP WIRELESS EQUIPMENT.—The Panama Railroad have authorized the Atlantic De Forest Wireless Company to instal their wireless telegraph system on the steamers *Advance* and *Finance*, so that the whole fleet now plying between New York and Panama will thus be equipped. The De Forest Company has also equipped recently the *Ligonier* of the J. M. Guffey Petroleum Company plying South.

THE MILWAUKEE ELECTRIC RAILWAY & LIGHT COMPANY is installing ten 500-hp Edgemore boilers in the basement of its new office building in Milwaukee. These boilers will furnish steam for a central heating system, and during the peak of the lighting also will supply steam for three 1,500-kw turbo-lighting units which the company has just ordered from the Allis-Chalmers Company.

APPARATUS WANTED.—The city of Crowley, La., is in the market for a 200-kw single-phase, 133-cycle, 1,100-volt generator; and a second-hand machine will be purchased if in proper condition. Mr. A. Durio, the superintendent of the city lighting and water plant, would like to receive bids with details.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a heavy break in prices on the stock market early in the week from which, however, there was a sharp recovery, and at the close the market was firm in tone. There was strength in the United States Steel stocks as a result of the favor with which the figures of the December quarter and of the year were regarded by the traders. Standard railroad stocks were fairly uniform. Electric securities were weak and neglected, comparatively little business being done. Both the Allis-Chalmers issues declined 1 point, common closing at 24 and preferred at 63. General Electric fell to 172 during the week, but recovered some of the loss and closed at 175¼, which is a net decline of 2 points. Westinghouse closed at the lowest price of the week—166—this being a net loss of 2 points. Although there was an active business in Brooklyn Rapid Transit the course of prices was downward, 86⅝ being the closing quotation, a decline of 5 points. Metropolitan Street Railway lost 4 points, closing at near the lowest quotation of the week, 120¾, and Interborough Rapid Transit lost 2⅛, the closing price being 233⅞. The telegraph stocks show gains on the week's business, Western Union closing at 93⅝, an advance of ¾, and American Telegraph & Cable at 93, a net gain of 3 points. American Telephone & Telegraph was steady at 139, closing at that figure, which represents a decline of 2 points. On the curb market Mackay Companies closed at 60½, a net loss of 2 points. The principal feature of the week's trading on the curb was a sharp rise of more than 13 points in United Copper common stock, to a new high record. The preferred rose half as much. Pools in the other copper stocks took the opportunity to run up their specialties so as to get a better chance to distribute them. But at the end of the week, as many "coppers" showed declines as advances. United Copper lost some ground in the absence of confirmation of the reports about its absorption by the Amalgamated Company. Contracts for new Interborough Metropolitan stocks were weak, as a result of some dissatisfaction with the plan and misgivings in regard to the financial position of the Metropolitan Securities Company. Following are the closing quotations on the Stock Exchange February 6:

NEW YORK

	Jan. 30	Feb. 6		Jan. 30	Feb.
Allis-Chalmers Co	23⅛	24¾	General Electric	173	178
Allis-Chalmers Co. pfd	62⅛	63⅝	Hudson River Tel.	...	...
American Dist. Tel.	37	37	Interborough Rap. Tran.	232	233
American Locomotive	74⅝	76	Mackay Cos.	59⅝	60½
American Locomotive pfd.	118¼	118⅜	Mackay Cos. pfd.	73	74⅜
American Tel. & Cable	87	91	Marconi Tel.	...	...
American Tel. & Tel.	137	138⅛	Metropolitan St. Ry.	121⅜	121¾
Brooklyn Rapid Transit	88⅛	88	N. Y. & N. J. Tel.	...	...
Electric Boat	25	25	Western Union Tel.	93¼	93⅝
Electric Boat pfd.	60	60	Westinghouse com.	166	166
Electric Vehicle	17	16	Westinghouse pfd.	...	..
Electric Vehicle pfd.	22	19			

BOSTON

	Jan. 30	Feb. 6		Jan. 30	Feb. 6
American Tel. & Tel	139	139¾	Mass. Elec. Ry. pfd.	67⅛	67
Cumberland Telephone	117	...	Mexican Telephone	...	...
Edison Elec. Illum.	..	...	New England Telephone	139	137
General Electric	...	...	Western Tel. & Tel.	...	14
Mass. Elec. Ry.	...	18¼	Western Tel. & Tel. pfd.	82⅛	..

PHILADELPHIA

	Jan. 30	Feb. 6		Jan. 30	Feb. 6
American Railways	53	53	Phila. Electric	8¼	7⅞
Elec. Co. of America	11⅞	11⅞	Phila. Rapid Trans.	32	32¾
Elec. Storage Battery	81	81	Phila. Traction	...	...
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Jan. 30	Feb. 6		Jan. 30	Feb. 6
Chicago City Ry	200	200	National Carbon	80½	81½
Chicago Edison	...	...	National Carbon pfd.	116	117¼
Chicago Subway	...	...	Union Traction	...	...
Chicago Tel. Co	...	...	Union Traction pfd.	...	...
Metropolitan Elev. com.	26	26			

OTTAWA TROLLEYS ANNUAL.—President T. Ahearn is able to make a splendid showing for the Ottawa (Can.) Electric Railway Company last year. The statistical statement of the company from the year 1891 to 1905, inclusive, presented at the recent annual meeting, was very complete and most interesting, showing the great strides annually made by the company since its inception. For purposes of comparison the business of the old horse car line was produced, which showed that in the year 1885 the total earnings of the Ottawa City Passenger Railway Company (horse cars), were $19,186, and the number of passengers carried was 383,720. Ten years later, in 1895, the Ottawa Electric Railway Company carried 4,583,000 passengers, and its receipts swelled to $212,000. During the past year the number of passengers carried was 9,891,000, and the receipts increased more than 100 per cent to $449,633, the net profit for the past year being 14 3/10 per cent, from which 10 per cent was paid in dividends and bonus, leaving $44,000 to be applied to the reduction of plant and profit and loss accounts. The system was operated at a net profit of 14 3/10 per cent, said to be the largest percentage shown by any Canadian road.

BELL TELEPHONE GROWTH.—During the past three years the outstanding capital stock of the American Telephone & Telegraph Company has increased from $87,836,100 on January 1, 1903, to $131,551,400 on January 1, 1906, a gain of $43,715,300, or 49 per cent. In the same time the growth in the number of stockholders has more than kept pace with the increase in the amount of stock. Stockholders on January 1, 1906, numbered 17,565, against 10,802 on January 1, 1903, a gain of 6,763, or 62 per cent. The following table gives the number of stockholders as of January 1, 1903, 1904 and 1906, and the amount of capital outstanding on those dates, together with the average number of shares held by each stockholder:

	Outstanding capital stock.	No. of stockholder.	Aver. shares per stockholder.
Jan. 1, 1903	$87,836,100	10,802	81.3
Jan. 1, 1904	127,668,900	15,743	80.7
Jan. 1, 1906	139,551,400	17,565	74.8

The average holdings per stockholder have decreased 6.5 shares, which indicates a constantly growing constituency of shareholders.

CUMBERLAND TELEPHONE.—The Cumberland Telephone Company has issued its full pamphlet report for the year ending December 31, 1905:

	1905.	1904.	1903.	1902.
Gross	$4,656,423	$4,027,117	$3,480,042	$3,070,163
Expenses	2,976,971	2,585,807	2,170,919	2,068,184
Net	$1,679,450	$1,441,309	$1,309,123	$1,001,979
Interest and taxation	320,166	267,142	269,031	219,814
Surplus	1,359,284	1,174,167	1,040,092	782,165
Dividends	940,691	818,674	766,382	623,203
Surplus	$418,592	$355,492	$273,710	$158,962

DIVIDENDS.—Directors of the North American Company have declared the regular dividend of 1¼ per cent on the stock of the company. It is payable March 1. The directors of the Pennsylvania Telephone Company have declared a quarterly dividend on 1½ per cent. Directors of the American Graphophone Company have declared a quarterly dividend of 1¼ per cent, payable March 15, to stockholders of record March 1. The directors of the Philadelphia Company declared the regular semi-annual dividend of 2½ per cent on the preferred stock, payable March 1.

WESTERN ELECTRIC REPORT.—According to the annual report, the gross earnings of the Western Electric Company for last year were $44,146,000, an increase of 36 per cent. The stockholders have voted to increase the capital to $25,000,000 and $3,000,000 of treasury stock will be issued immediately. Stockholders may subscribe in proportion of 25 per cent of their present holdings. The company's sales are now averaging $4,500,000 monthly.

CANADIAN BELL TELEPHONE.—The Bell Telephone Company of Canada is applying to the Dominion Parliament for the right to increase its capital over and above the present authorized amount of $10,000,000. At present the company has issued $9,000,000 of common stock, although that will not be fully paid until next July. The last issue was $1,000,000, made on May 31, 1905.

MANILA ELECTRIC RAILWAY.—The operating department of J. G. White & Company reports the earnings of the Manila Electric Railway & Lighting Corporation for December and January as follows: December, railway department, gross, $48,750; net, $24,750; lighting department, gross, $28,500; net, $12,900; total net, $39,600. January, railway department, gross, $44,450.

PURCHASE OF DETROIT GAS.—The American Light & Traction Company has acquired control of the Detroit City Gas Company. It is for the purpose of securing funds for the purchase of this property that the Light & Traction Company is now offering 15,000 shares of common stock and 40,000 shares of preferred stock.

WESTINGHOUSE EARNINGS.—Advices from Pittsburg state that the orders booked in its railway department by the Westinghouse Electric Company for the month ending January 31 amounted to $2,000,000, the largest for any month in its history. Semi-official estimates place the probable total business for 1906 at $40,000,000.

SOUTHERN NEW ENGLAND TELEPHONE.—The capital stock of the Southern New England Telephone Company is to be increased by $1,000,000, making the total issue $6,000,000. President Tyler, of the company, believes the new issue will be disposed of at not less than $120 a share.

General News.

NORTH BIRMINGHAM, ALA.—The Mayor will probably soon be asked to call an election to vote on an issue of $50,000 bonds for improving the water and light plants.

PRAIRIE GROVE, ARK.—The Prairie Grove Light & Power Company has closed down its plant for the reason that there was not sufficient demand for power to justify its continued operation. The plant will either be sold or moved to some more favorable location.

RIO VISTA, CAL.—A franchise was granted to the Rio Vista Electric Light & Power Company by the Board of Town Trustees at their last meeting, which gives the company the right to operate and maintain an electric light and power plant in the town of Rio Vista.

HOLTON, CAL.—The Holton Electric Company, El Centro, Cal., has concluded the purchase of new electrical equipment through the San Francisco office of the Allis-Chalmers Company, Milwaukee, consisting of type "AN" induction motors, transformers of the oil-filled, water-cooled type, and transformers of the self-cooled type.

SAN FRANCISCO, CAL.—An offer has been made to this city by J. E. Russell to furnish San Francisco with a supply of water and electric energy from the American River near Auburn. The cost of fully equipping the plant is put at $500,000, and the promoters of the scheme say that it would yield an income sufficient to pay the interest on $20,000,000.

SAN FRANCISCO, CAL.—What is said to be the largest telephone switchboard in the United States outside of New York and Chicago, will soon be installed in the new main "Central" Exchange building on Bush Street. All the apparatus has arrived and the work of making the connections will begin at once. The board is of the improved multiple type and is capable of accommodating lines for 22,300 telephones. There will be 15,000 incandescent signal lamps.

ALTA, CAL.—The power plant of the old Central California Electric Company, now owned by the Pacific Gas & Electric Company, is again running at its full capacity. For a number of weeks past the power house has been doing only a small amount of work, owing to the scarcity of water. There is now plenty of water all through the mountains. The reservoirs and ditches of the South Yuba Water Company are full almost to overflowing and the snowfall farther up the mountains promises a good supply next summer.

YREKA, CAL.—The Siskiyou Electric Power Company has completed the branch pole line to Hornbrook and is now lighting and supplying power in that town. A 1,000-kw generator has arrived in San Francisco and will be installed as soon as the weather conditions permit. This is the second generator to be installed at the Fall Creek plant. From present indications there will be installed in and about Yreka during the coming summer four new gold dredgers which will be operated with electricity furnished by the company.

SOUTH NORWALK, CONN.—The municipal lighting plant of the city of South Norwalk has closed another satisfactory year. It is stated that the gross profit for 1905 amounted to $11,208, an increase of nearly 100 per cent. over the previous year.

WINDSOR LOCKS, CONN.—It has been learned recently that it is the intention of the new management of the electric light company to make all of its future lighting contracts on the meter basis instead of a flat rate. All of the places now having light on the one-payment system will probably be asked to change to a meter in the course of the next month.

NEW HAVEN, CONN.—The United Illuminating Company, which has to do with lighting New Haven and Bridgeport electrically, has issued letters to its customers in the Whitney avenue section of the city, notifying them that on and after February 15 a day service will be afforded such customers. This will greatly help the sale of electricity and apparatus.

SMYRNA, DEL.—It has been decided by the Town Council not to sell the electric light plant to the Smyrna, Kent County & Delaware Bay Traction Company, and improvements will now be made in the plant, including the installation of a new boiler and a 60-kw dynamo.

ALBANY, GA.— Because of the fact that the city of Albany owns the electric lighting plant, the municipality has rejected the applications of private parties for gas privileges, as it is not desired that the city shall have competition in the lighting business.

POCATELLO, IDAHO.—The American Falls Power, Light & Water Company, Ltd., has sustained a $15,000 fire loss at its sub-station in Blackfoot.

BATH, ILL.—A Jacksonville company has been awarded the contract for installing an electric light plant here.

CHICAGO, ILL.—The Abbott Alkaloidal Company has added a power house to its plant, equipping it with an Erie 125-hp water tube boiler, Hawley furnace, Chuse 125-hp engine and a Jenney 75-kw generator.

PONTIAC, ILL.—The large flywheel at the Pontiac Electric Company's plant broke recently, and for an indefinite period traffic on the interurban railroad between this city and Odell will be suspended. It will probably take thirty days to make repairs. The Pontiac Shoe Manufacturing Company's plant, which is furnished power by this company, was also closed down. The loss is estimated at about $6,000.

EDWARDSVILLE, ILL.—The deal for the sale of the Edwardsville Electric Light & Power Company's plant to the McKinley syndicate has been closed and the new management has taken charge of the affairs of the company. The McKinley people have secured a fifty-year franchise from the city, and will assume the public lighting contract between the local company and the city, which has about four years to run.

LAFAYETTE, IND.—The Fountain Warren Traction Company has made application for a franchise for entrance to the city.

ALEXANDRIA, IND.—The Alexandria Electric Light & Power Company has been placed in the hands of the Anderson Trust Company, as receiver. The plant has valuable contracts, with a large local patronage, and is solvent. Disagreement among the stockholders brought about the complications. The receiver will add some new machinery and keep the plant in first-class condition.

ROCK ISLAND, IA.—At a recent meeting of the City Council it was decided to ask the Central Union Telephone Company to present a new ordinance. The company and council have been in dispute ever since the council repealed the telephone ordinance in 1902, and left the company without a franchise.

OSKALOOSA, IA.—Harry O'Neill and J. Springfield, principal owners of the Oskaloosa Traction & Light Company, have sold their interests to J. B. Sax, Samuel Mahon and other Ottumwa stockholders. It is understood that the whole property will be sold to the same company that recently bought the Ottumwa property. Mr. O'Neill will now devote his entire time to building the Oskaloosa & Buxton Interurban Railway, of which he is president.

MASON CITY, IA.—The People's Mutual Telephone Company, which operates toll lines and exchanges between and at several towns in Franklin and Cerro Gordo counties, has been sold to a new syndicate headed by Charles F. Johnson, a former member of the Legislature of Iowa. Associated with Mr. Johnson in the new deal are E. N. Egge of Rockwell and C. M. Felland of Joyce, Ia. The towns connected by this system and maintaining exchanges are Chapin, Latimer, Coulter, Alexander, Sheffield, Rockwell and Thornton.

HUGO, I. T.—William Busby has been granted a 50-year franchise to construct and operate an electric light system in this city.

LOUISVILLE, KY.—This city is considering the placing of all telephone and electric light wires in the central part of the city underground, and has consulted with Engineer D. J. T. Jeup, of Indianapolis, Ind., with regard to the matter.

LOUISVILLE, KY.—The Louisville Gas Company, through its directors, has been cited to appear before the General Council to show the exact relations existing between this company and the Louisville Lighting Company.

LOUISVILLE, KY.—The North American Company is an applicant for a franchise for lighting and heating privileges in Louisville and copies of the charter which it desires will be presented to the General Council after such changes as are deemed necessary have been made in the original charter copies.

LOUISVILLE, KY.—The lower board of the Louisville General Council has opened the way for competition in the electric light and power field by passing an ordinance providing for the sale of a franchise for furnishing light, heat and power in the central portion of the business district. The ordinance forbids any other company or individual now holding a franchise for this territory to purchase or acquire the franchise, and gives the General Council authority to control the rates. It is understood that the North American Company is asking for a franchise covering the whole city.

WINNFIELD, LA.—The Winnfield Electric Light & Power Company has been given a franchise to construct and operate an electric light and power plant.

BANGOR, ME.—The Bangor Electric Light Company is to replace its present power equipment with new apparatus, which will be furnished by the General Electric Company.

PRESQUE ISLE, ME.—Mr. A. R. Gould, general manager of the Maine and New Brunswick Electrical Power Company says that negotiations are in progress with contractors for the necessary ledge excavation, which will be the first step in the actual work in the development of the power at the falls.

BANGOR, ME.—The Bangor & Northern Railway, formerly the Penobscot Central, an electric line extending from Bangor to Charleston, a distance of 26 miles, has been sold to the Bangor Railway & Electric Railway Company, which now controls all the local and suburban electric railways.

MELROSE, MASS.—Petitions are being prepared for presentation to the Board of Aldermen, requesting that an all-night lighting service be established.

WINCHESTER, MASS.—At a recent meeting of the Selectmen a number of citizens expressed considerable dissatisfaction with the rates and service of the electric light company, and a good deal of discussion was heard which seemed to favor establishing a municipal lighting plant.

DANVERS, MASS.—The additions and extensions at the municipal electric plant, for which the town appropriated $20,000 at the last annual meeting, are practically completed. The new engine and a large new arc dynamo will increase the street lighting capacity to about 225 enclosed arc lamps, the present number being about 125.

MARLBORO, MASS.—The Marlboro Electric Company, we are informed by Mr. C. B. Russell, treasurer, has established a 24-hour service and will push the power end of the business. It has secured an additional 100-kw generator, General Electric make. The contract with the city requires the company before August 1 to replace its open-arc street

lamps with enclosed arcs. This will require the installation of a 150-kw generator unit.

PARMA, MICH.—It is understood that at the spring election the question of electric lighting will be voted upon.

SHERMAN, MICH.—A dam for the development of power is to be constructed across the Manistee River near this place. The Manistee Engineering Company, of Manistee, is in charge of the work.

MORRICE, MICH.—Morrice has signed a contract with the Saginaw Electric Lighting Company for electric lighting; Bancroft and Perry will also be supplied. The lamps are to cost $50 each per year.

CADILLAC, MICH.—Manistee River Power Company has received its franchise from the Supervisors. The dam and power house on Manistee River are to be in readiness for business by April 1, 1910.

GRAND RAPIDS, MICH.—At the meeting of the stockholders of the Grand Rapids Edison Company, recently held in this city, the following officers were chosen: President, Daniel McCool; vice-president, McGeorge Bundy; secretary and treasurer, Thomas F. Bechtel; general superintendent, A. F. Walker. It is said that the company contemplates increasing the present capacity of the plant within the next year.

DETROIT, MICH.—The city will not be taxed very heavily this year by the Public Lighting Commission, as most of the work done will be the carrying out of plans undertaken last year, for which $149,000 bonds were issued, and which include an enlargement of the plant, extension of trunk lines, the establishment of a branch station in the West End and the equipment of 200 new lamps. The new lamps will be installed in the spring and an outlay of some $20,000 will be made in the new Eighteenth Ward, which will be served by the proposed McKinstry Avenue branch station. The existing contract with the Solvay Process Company will probably be renewed until the proposed extensions and improvements have been completed.

CROOKSTON, MINN.—The Tri-State Telephone Company is asking for a franchise in this city.

ST. JOSEPH, MINN.—A municipal lighting business is about to be conducted by the Sisters of St. Benedict, of this place. The St. Benedict Sisters have been operating a power plant to light the academy, and on petition of the residents of the town they have agreed to extend the service to the streets and business houses of the municipality. Plans for the extension have been completed and the necessary work of stringing the wires, etc., has begun.

LITCHFIELD, MINN.—The city council held a special meeting to consider the request of the Tri-State Telephone Company for a reduction of the rate of electricity for telephone use. The company is being charged the regular rate of 10 cents per kw-hour, same as is paid by all users of electricity for lights. After some talk a motion was passed unanimously that the rate be left as it is. The Tri-State Company threatens to put in a gasoline engine and dynamo of its own if the rate is not reduced.

ST. LOUIS, MO.—At the last meeting of the Board of Aldermen of Kirkwood, a suburb of St. Louis, all ordinances recently enacted pertaining to the sale of the municipal electric lighting plant to the General Service & Development Company, a subsidiary institution of the North American Company, and the granting of a twenty-year franchise to an allied gas company, were repealed. An election was to have been held February 17 to determine by popular vote the sale of the plant. This was declared off. The action was a surprise to the whole community as it was thought that there would be no difficulty about selling the plant for $25,000. It is said that the reason for the repeal was that the General Service & Development Company had failed to comply with the ordinance, which demanded that the sum of $4,000 be deposited with the Bank of Kirkwood within three days after the drafting of the ordinance. The concern deposited $4,000 about three days ago with the St. Louis County Trust Company at Clayton.

CAPE GIRARDEAU, MO.—At the annual meeting of the Cape Girardeau Water Works & Electric Light Company all the directors and officers of the company were re-elected. A new schedule of rates was arranged whereby large consumers will pay 7 cents per kw-hour instead of 10 cents. The schedule is as follows: Consumers using less than 250 kw-hours a month, 10 cents; 251 to 300, 9 cents; 301 to 500, 8 cents; 501 and over, 7 cents. The company also voted to install new lamps.

KIRKWOOD, MO.—A special election will be held February 17 at which the people will decide whether or not the lighting plant shall be sold for $25,000 to the General Service & Improvement Company, an alleged subsidiary concern of the North American Company.

MISSOULA, MONT.—At a special meeting of the City Council, the contract for lighting the city of Missoula was granted to the Missoula Light & Water Company, the only bidder, for a term of ten years.

RENO, NEV.—The latest report concerning the consolidation of the various electrical and public utility companies of Reno and Sparks is to the effect that every electrical power plant and power site of importance on the Truckee River from the fountain head of the stream to Vista, ten miles below Reno, is to be taken over by an Eastern syndicate which wishes to get control of the electrical facilities of Western Nevada. According to the report, an option on all their properties has been given by the Fleishackers, and if the price is satisfactory to the syndicate the deal will soon be made. If the sale goes through it will transfer property worth five or six million dollars, and carry with it not only the two big power plants which light Reno and Sparks, but the immense stations at Marmel and Floriston, which run the Floriston paper mill and furnish power to drive the machinery and pumps of the Comstock mines, as well as to light Virginia, Gold Hill, Carson, Dayton and Empire. Capitalists are awakening to the possibility of the Truckee River for the development of electric power. The fall of the river makes the fluming of water for a great distance unnecessary and as the country is developing at a rapid rate the demand for power increases. Not only are new mines opening up east of Reno that will be consumers of many hundred horsepower, but the Western Pacific contractors in their tunnel work are within easy distance of several of the large generating stations.

BERLIN, N. H.—By the middle of February, the Cascade Light & Power Company of Berlin will have installed a new generator at its power plant in Gorham which will increase the capacity of the plant to double its present amount. The order for the generator has been placed with the Stanley-G. I. Electric Manufacturing Company. This company already has two generators, one of a hundred odd kilowatts for the use of the Berlin Electric Railway Company, and one of 200 kilowatts for lighting and power in Berlin. The company has elected the followng officers: R. N. Chamberlain, president; Giles O. Holt, treasurer; C. C. Gerrish, clerk; directors, Messrs. Chamberlain, Gerrish, R. S. McKenzie, Berlin; A. B. Libby, Gorham, and Mark A. Twitchell, Milan.

BLOOMFIELD, N. J.—The Town Council has renewed the lighting contract with the Public Service Corporation for a term of five years, beginning February 1. Under the new contract a saving of $2 a year on each arc lamp is secured, the price stipulated being $70 per lamp of 1,200 cp. The incandescent rate is the same as heretofore, $16 per lamp. A discount of 25 per cent is granted on all lights used in the Council chambers and the police station. This represents a saving to the town of $1,000.

SALEM, N. Y.—The town board of Salem met recently at Shushan for the purpose of letting a contract for the lighting of that village by electricity. L. C. Piser was awarded the contract for furnishing thirty-eight incandescent lamps, the same as the last contract, at $8.50 per lamp for every night and all night for the term of five years commencing January 1, 1906.

DUNKIRK, N. Y.—The Dunkirk & Fredonia Street Railway Company has been sold for $375,000 to H. W. Noble, of Detroit, Mich., who is believed to be acting for the Buffalo, Dunkirk & Western interests.

ITHACA, N. Y.—The Ithaca Telephone Company has recently completed arrangements for connections with several smaller companies which have broken off their associations with the Bell Company for this purpose.

TICONDEROGA, N. Y.—In the matter of the application of the Ticonderoga Electric Light & Power Company for consent to issue bonds to the amount of $50,000, and in which a hearing was held recently, the State Commission of Gas & Electricity has granted consent to the issuance of bonds to the amount of $35,000.

NIAGARA FALLS, N. Y.—Another transmission company is said to be preparing to enter the American field. This is the Electrical Development Company, getting its power from the Electrical Development Company of Canada, which was formerly known as the Toronto & Niagara Power Company. The plant of this company will not be completed for several months, but it is stated that it will apply for entrance to Buffalo and will compete with the Niagara Falls Power Company. It has also a transmission line to Toronto.

ROCHESTER, N. Y.—Mayor Cutler has approved the ordinances directing the corporations maintaining overhead wires in University Avenue, Merriman Street and Clinton Avenue North to remove the poles from the streets. The formal notifications have been sent. The Rochester Railway & Light Company has already expressed a willingness to remove the poles and a gang of men in the employ of the company has been at work for two days removing the poles on University Avenue. Conduits have been constructed in all the streets mentioned and all the wires will be buried.

FULTON, N. Y.—The report is current in this city that the Fulton Light, Heat & Power Company and the Fulton Fuel & Light Company are about to combine and that the two concerns will be run under one head. The Fulton Heat, Light & Power Company supply the electricity for the street lighting and also for domestic lighting and heating and also for power in different of the manufacturing places in this city. The gas company furnishes gas for commercial lighting and heating, having built a plant at the southern end of the city. The two companies about split up the business and it is the desire of many of the persons interested in each to combine. The matter, it is understood, has been under consideration for some time, though the report is not confirmed.

YOUNGSTOWN, OHIO. — Two new companies are said to have applied for a charter for an electric railway from New Castle to Ellwood City via Pittsburg, to cost $1,000,000.

STEUBENVILLE, OHIO.—A new traction company is said to have made application for traffic privileges, which will probably be granted. The new line will start at Minerva and touch Osnaburg, Sparta, Carrollton, North Industry, Waynesburg and other towns in that section.

TOLEDO, OHIO.—At the annual meeting of the Toledo & Western Railway, Judge C. M. Stone, of Cleveland, was elected president and counsel in place of the late Hon. Luther Allen. Other officers are J. R. Seagrave, vice-president; F. E. Seagrave, secretary and treasurer; C. E. French, auditor, and C. F. Franklin, general manager.

CINCINNATI, OHIO.—An ordinance has been prepared by the General Council, asking for bids on an electric light franchise. At least 250 arc lamps are required, and the bids will be received in two forms—one fixing the price for the arc lamps and asking for a bonus and the other a straight bid on the price of street lighting.

YOUNGSTOWN, OHIO.—Youngstown may in a few years own its

own electric light plant. The City Council has taken the preliminary steps for a municipal lighting plant by referring the matter to a committee, which will make a report on the cost of a plant. The city now pays nearly $40,000 a year for a very unsatisfactory system of street lighting.

LIMA, OHIO.—The Bell Telephone Company announces a cut in rates for resident service here to $1.50 for individual telephones and $1.25 per month for two-party lines, and will discontinue the use of all four and ten party lines. All the wires have been placed under ground and an active canvass is to be made for subscribers against the independent system which has secured a great lead in patronage during the past five years.

TOLEDO, OHIO.—The Toledo Gas, Electric & Heating Company has accepted the nine-cent commercial electric lighting rate fixed by the former City Council. The Rail-Light accepted this rate some time ago, and with the action of the Heat-Light, consumers will soon be enjoying the benefits of a reduction in prices. The companies have, in past years, been charging as high as 13 cents a kw-hour.

CALDWELL, OHIO.—A deal has been closed by which the largest of the telephone companies operating in Noble County have consolidated under the name of the Noble County Telephone Company. The companies in the combine are: The Caldwell Independent Telephone Company and the Farmers' Telephone Company of Caldwell; the Summerfield Telephone Company of Summerfield and the Caldwell & Marietta Telephone Company of Washington County. The system will be managed by the United States Telephone Company. The company will have 200 miles of toll line.

COLUMBUS, OHIO.—At a meeting of the Board of Directors of the Columbus Gas Light & Heating Company, the holding company of the Central Ohio Natural Gas & Fuel and the Columbus Gas Companies' plans for the consolidation of the underlying companies were perfected. Accordingly the consolidation of the two companies took place, instead of a merger of the three, and the Columbus Gas Light & Heating Company will pass out of existence. To supplant this it was decided to form the Columbus Gas & Fuel Company, with a capital stock of $9,000,000. The liquidation of the Columbus Gas Light & Heating Company and establishing in its place the Columbia Gas & Fuel Company was thought better than the merger plan, since under this arrangement no transfer of franchise privileges is necessary.

BAKER CITY, ORE.—The Rock Creek hydro-electric plant of the Baker Light & Power Company, situated in the mountains 18 miles west of Baker City, is now supplying electricity for light and power purposes to this city and several mines in the vicinity. As an adjunct to this plant the company is erecting an auxiliary steam plant at South Baker City, which will furnish power and lights to the city in cases of emergency.

PITTSBURG, PA.—The contract between the city and the Allegheny County Light Company expired February 1, but the company will continue to furnish lights at the contract price, $96 per year, until a new arrangement is made. Director E. M. Bigelow advocates making the term of the new contract four years, claiming that it will mean a saving of $50,000 a year to the city.

YORK, PA.—The Merchants' Electric Heat & Light Company, of this city, has been awarded the contract for lighting the borough of North York for the ensuing year. The cost of each light will be 11 cents per night, or 3 cents less on each light than the borough is at present paying. There were only two bids for the contract considered, the other being from the Edison Electric Light Company. The present contract with the Merchants' Electric Heat & Light Company, which has been in operation for three years, will expire March 1.

PHILADELPHIA, PA.—The Philadelphia Electric Company is now considering making a general reduction in the price of light and power in the district covered by the Edison Company. This district embraces the territory bound by Lombard and Callowhill Streets and the Delaware and Schuylkill Rivers. When the announcement was made Thursday that all territory in the city excepting this section would be granted a general reduction in price it brought forth a general protest from storekeepers, manufacturers and others in the central district. Andrew J. De Camp, manager of the Philadelphia Electric Company, discussing the matter said that the fact that the distributing cables in the territory named were under ground added largely to the cost of maintenance, and also referred to the interest on the investment. The company is figuring, however, on the cost of furnishing light and power within that area at a reduction if it is practicable. Until that investigation is completed it cannot be said whether it would be commercially possible to reduce the price below the present rate of fifteen cents per kilowatt-hour. The reduction in price for all other districts made on February 1 establishes a uniform rate for the whole of Philadelphia outside of the Edison district. For some time prior to February 1 only ten cents per kilowatt-hour was charged in several parts of the city, including the district south of South Street, north of Callowhill to Lehigh Avenue, and east of Broad and in some sections west of Broad on this side of the Schuylkill. Under that uniform rate of ten cents per kilowatt-hour domestic electric lighting in this city is placed on a par with gas.

UNION, S. C.—At its regular annual meeting, the Union Manufacturing & Power Company, which recently completed its big power plant at Neals Shoals near here, elected directors who subsequently elected the following named officers: Edwin W. Robertson, president and treasurer; Emslie Nicholson, vice-president; W. P. Heineken, secretary and general manager. This may terminate the proceedings for receivership which have been pending for several weeks, and if nothing untoward happens it is likely that the electrical power will be turned on in the mills in a short time.

ANDERSON, S. C.—The Savannah Power Company, capitalized at $1,000,000, has been organized in this city by the election of the following named officers: H. A. Orr, president; C. Elmer Smith, of York, Pa., vice-president; Dr. S. M. Orr, treasurer; E. K. Chapman, secretary. The company will develop the water powers at Cherokee and Gregg shoals in Savannah River. Work on the new plant will begin within thirty days.

COLEMAN, S. D.—Miller Brothers are said to have purchased the telephone business of the Coleman Electric Company.

STURGIS, S. D.—The Allison Bros., of Lead City, are negotiating for the purchase of the Sturgis electric light plant from S. A. Oliver, but the deal has not yet been closed. The transfer is held up pending the adjustment of some matters which have to do with the future plans of the purchaers. If the sale is consummated, possession will probably not be given until March 1.

BROWNSVILLE, TEX.—Mayor F. J. Combe has returned from Corpus Christi and other Texas points where he has been investigating the electric light matter in order that the City Council may be prepared to more intelligently consider the question of granting a franchise for lighting Brownsville. The matter will be taken up at the next meeting of the Council..

SALT LAKE CITY, UTAH.—The Jordan Narrows power plant, formerly owned by the Salt Lake City Water & Electrical Power Company, has been transferred from W. S. McCornick & Co. to L. L. Nunn, of the Telluride Power Company. The consideration is $16,863.25. The ground involved in the transaction includes 16.3 acres. The power house is of brick and steel with equipment sufficient for generating and transmitting 4,000 horse-power. There is a spur track to the Rio Grande Western road, and water rights in the Jordan River and Utah Lake.

RICHMOND, VA.—An interesting debate is still in progress here regarding the matter of granting a lighting franchise to the Gould interests. Special Expert E. W. Trafford has prepared a pamphlet on the subject of municipal ownership, especially in Richmond. The paper is in part a reply to the argument of Henry W. Anderson, counsel for the Gould interests. Mr. Trafford states in reply to the claim that Richmond gets lighting at a cheaper rate than any city of its size in the country, that there are 262 cities getting cheaper lighting than Richmond, according to the report of the National Electric Light Association. The fight over the franchise has been on for quite awhile and there seems to be no immediate possibility of settlement.

LAKE PADDEN, WASH.—The Valley Shingle Company is installing an electric light plant in its factory, which will supply lights to the village.

BALLARD, WASH.—The Ballard Electric Company, which holds a fifty-year lease of the present pumping plant of the city, has made a proposition to sell the city its lease for $15,000, and the building for $3,900. These terms were rejected by the Council, however, and it is possible that the city may install its own plant, which, it is said, can be built and equipped with pumps for about $4,000 or $5,000.

CHIPPEWA FALLS, WIS.—It is reported that a deal has just been closed, whereby the Bell Telephone Company assumes control of the Cadott, Thorpe and Ludington lines.

BELOIT, WIS.—The Beloit Water, Gas & Electric Light Company, which is a consolidation of the Beloit public utilities, has obtained a contract to supply the Atwood-Davis Company, of South Beloit, with electric power for five years at $1000 a month, or a total of $60,000. A special line will be constructed to the gravel lands of the Atwood-Davis Company.

WAUSAU, WIS.—The municipal lighting plant, installed by Mr. Jacob Cloos, of Milwaukee, is reported to have made a good showing last year. The report shows that the total cost of the plant was $12,062.66. The cost of maintenance and repairs was $190.80. The cost of electric current was $3,224.19. The salary of the electrician was $600. The total number of hours the lamps burned was 3,293, and the average number of lamps in use was 104½. Interest and depreciation on the plant are each figured at 4 per cent. On this basis the cost per lamp is put at $47.65 per year.

MORGANTOWN, W. VA.—At the last session of the Common Council a franchise was granted to the Dunkard Valley Railway Company, which proposes to operate a trolley line between Morgantown and Mannington.

INGERSOLL, ONT.—The Council has entered into an agreement with the Ingersoll Electric Light & Power Company to furnish 45 arc lamps of 2,000 nominal candle-power, all night, for $2,500 per annum, the contract to date from July 1, 1906. In the meantime the present contract will be continued. A clause in the agreement promises that should Niagara power cheapen the cost of electric light any time during the life of the contract the company is to furnish the corporation with light as cheap as any town in the province similarly situated.

PORT HOPE, ONT.—The lighting contract between the city and the Port Hope Electric Light & Power Company, Ltd., expired in December, since when the company has been supplying light without contract or agreement at the old rate. The Council has been considering the possibilities of a municipal lighting system before making a new contract with the lighting company, and when on presentation of the company's bill for the January lighting, the Council refused to pay the full amount, the arc lamps were turned off. The company states that if the pole franchise is cut off, it will shut off the incandescent lamps also.

Construction Notes.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company, which expended $500,000 in improvements last year, announces that probably $800,000 will be expended this year.

MONTGOMERY, ALA.—The Citizens' Light, Heat & Power Company is preparing to expend about $50,000 this year in improvements to its plant and system. P. R. Whiting is manager of the company.

ANNISTON, ALA.—The Anniston Gas & Electric Company has accepted the franchise recently granted by the City Council of Oxford for the building of an electric railway to Hobson City, and the company will make immediate application to the authorities of Hobson City for a franchise to extend the line to Hobson Park.

ROGERS, ARK.—The Rogers Electric Light Company has decided to construct an addition to its plant, and will install a 200-hp boiler, motors, etc.

HALFMOON BAY, CAL.—A franchise has been awarded to W. J. McFarland for a gas and electric light plant.

SANTA ROSA, CAL.—The surveyors of the Petaluma & Santa Rosa Railroad are now engaged in surveying a line for the road from the Washoe House north to this city.

SAN FRANCISCO, CAL.—A project is on foot to use the waters of the Sutro tunnel for power in the mines of the Comstock. It is planned to erect a power plant at the town of Sutro.

KLAMATH FALLS, CAL.—C. N. Hawkins, president of the Klamath Canal Company, has asked for a franchise for an electric railway from the north city limits to connect with navigation on the water front of the Lower Lake.

PALO ALTO, CAL.—A municipal bond issue of $75,000 has been voted by the citizens of Palo Alto, $50,000 of which will be expended on the extension and improvement of the municipal water and electric lighting plant.

SANTA BARBARA, CAL.—The Pacific Coast Railway is planning an electric railway from Santa Maria to Guadalupe. The new road will receive power from the Valley Electric Company which is about to enlarge the capacity of its plant.

SAN FRANCISCO, CAL.—A special meeting of the stockholders of the Pacific Gas & Electric Company will be held at the office of N. W. Halsey & Co., 326 California Street, March 20, for the purpose of authorizing an increase in the company's bonded indebtedness from $10,350,000 to $14,850,000.

RED BLUFF, CAL.—Manager F. V. D. Johnson, of the Northern California Power Company, has announced that his company is about ready to commence the construction of a power line from Chico to the new sugar beet town of Hamilton in Glen County. The line will carry from 80,000 to 100,000 volts.

LOS ANGELES, CAL.—The Erchenbrecher Syndicate, of Los Angeles, has offered a right of way through its extensive holdings to the Pasadena Railway company for an electric railway from Pasadena to Eagle Rock, Glendale, and Griffith Park, to connect with the system of the Los Angeles Railroad Company at Ivanhoe.

OAKLAND, CAL.—The Sunset Telephone & Telegraph Company has been given permission to lay an underground telephone conduit on East Fourteenth Street. The company also contemplates extensive improvements to its system in the vicinity of Truckee, this state, part of which will consist of changing all ten-party lines to two-party lines.

BAKERSFIELD, CAL.—The Board of Directors and other officials of the Edison Electric Company of Los Angeles recently inspected the work on the large hydro-electric power plant which is being built in Kern River Canyon. As soon as work on this plant is completed the Edison Company will begin work on two additional large plants, one just above the intake of the new eight-mile tunnel and the other above Kernville.

ALAMEDA, CAL.—The contract for the high-speed engine for the additional unit to be installed in the municipal electric plant here, has been awarded to Charles C. Moore & Co., of San Francisco. The engine will be direct-connected to a 250-kw three-phase, 60-cycle generator, to be supplied by the National Electric Company, of Milwaukee. This generator is practically a duplicate of a generator recently installed in the same plant. There is also a Westinghouse generator in operation there.

LOS ANGELES, CAL.—Property owners have offered the Huntington street railway interests of Los Angeles a 40-foot right of way for a line between Eagle Rock and Verango Park, a distance of about three miles. According to Chief Engineer George Kuhrts, the road between Los Angeles and Eagle Rock will be completed within the next sixty days and ninety days more would run the line into Verango.

LEADVILLE, COL.—The Leadville Telephone Company is to build a line to Denver.

PUEBLO, COL.—Local capitalists are asking for a franchise to operate a street railway system in Pueblo.

FORT MORGAN, COL.—At a recent election held for the purpose, the citizens voted for the establishment of a municipal electric light plant.

DENVER, COL.—While in Colorado recently in connection with plans for the development of certain water powers, Bion J. Arnold, of New York and Chicago, made a study of the possibilities of the use of electric power on the Denver & Rio Grande Railroad. He has rendered a report on this subject to the officers of the company.

GUNNISON, COL.—Bids will be received until February 21 for constructing a complete water system, including weir and dam on the Gunnison River, intake, flume, excavations, backfills, penstocks, pumps, connections fittings, turbines, generators, pipe, hydrants, etc., together with a building for the pumping machinery; also buildings and complete wiring for the installation and operation of an electric light plant, including wires, poles, transformers, etc. T. L. Thompson is Mayor, and John J. Huddart, of 41 Bank Block, Denver, is consulting engineer.

MIDDLETOWN, CONN.—The recent scare over the low grade kerosene oil has been the means of increasing the business of the Middletown Electric Light Company. Several residents of Portland and nearby places where the wires of the company extend, have had their residences wired. One man has had his barn wired as a precautionary measure.

MOODUS, CONN.—The Moodus & East Hampton Tramway Company is making an effort to finance its undertaking for the construction of an electric railway to connect Moodus and the manufacturing village of East Hampton, where connections could be made with the New York, New Haven & Hartford Railroad. Water power is available midway between the two towns mentioned, which are 10 miles apart.

PUNTA GORDA, FLA.—The Mayor has been asked to call an election for the purpose of deciding upon an issue of bonds of $18,000 for the construction of a wharf, water works and an electric light system.

LINCOLN, ILL.—There is said to be a good opening here for an electric light plant.

PARIS, ILL.—General Manager Farwell has received bids for the erection of a new telephone exchange.

CLINTON, ILL.—A survey is being run from Champaign to Decatur for an interurban railway to be built by the Interurban Syndicate next season.

QUINCY, ILL.—Engineers are preparing plans for a number of new telephone lines which will put Quincy independent subscribers in communication with important outside points.

AURORA, ILL.—C. C. Hinkley, City Electrician, writes that the proposed electric light plant will cost about $20,000. Bids for the construction have not yet been called for.

JACKSONVILLE, ILL.—Samuel B. Stewart, City Clerk, states that the City Council on February 1 voted not to make any appropriation for new machinery for the electric light plant, so that no improvements will be made in the plant during 1906.

FREEPORT, ILL.—Mr. A. J. Goddard, president of the Freeport, Ill., Railway, Light & Power Co., informs us that the city expects to install about 50 additional arc lamps on its new contract, which will involve an extension of about ten miles of pole line, including the essential lines that the company will put in to cover portions of the city not already served. A water power plant of about 700 hp down the river is contemplated as an extension.

BEDFORD, IND.—It is stated that the Indianapolis, Vincennes & Evansville Traction Company intends to begin the construction of its road in the spring.

PORTLAND, IND.—The work of making the survey for the extension of the Portland & Muncie Traction Company's line from Portland to Celina was begun January 30.

SOUTH BEND, IND.—Bids are wanted for three turbine water wheels, each capable of developing 200 hp at 10 ft. head, and all the accessories for the same. A. J. Hammond is the city engineer.

CRAWFORDSVILLE, IND.—The James H. Watson Company intends to erect a plant for the manufacture of galvanized iron products. It will need boilers, engines, dynamos and electrical supplies.

LOGANSPORT, IND.—The Indianapolis, Logansport & South Bend Traction Company has asked the Board of Public Works for entrance to the city. The enterprise is being promoted by Logansport and South Bend capitalists.

FORTVILLE, IND. — The Town Council is negotiating with the Indiana Traction Company to furnish electricity for lights and power for the town. If the negotiations fail a local company will be organized to build and operate a plant.

INDIANAPOLIS, IND.—The Indianapolis Southern Railway Company is preparing to install a new water plant at its shops in the southern part of the city and will make other improvements that will pave the way to the erection and installation of a light and heating plant subsequently.

WARSAW, IND.—The Peru-Warsaw division of the Winona Interurban Railroad will be built by the company instead of by a construction company under general contract, the sub-contracts being let for the actual construction. Bids, however, will soon be asked for the equipment. Dr. S. C. Dickey is president.

AFTON, IA.—The City Council has decided to install an electric street lighting plant for the town.

DES MOINES, IA.—A new switchboard is to be installed at the local exchange of the Iowa Telephone Company, and other improvements in the system will also be made.

FREMONT, IA.—The Farmers' & Traders' Telephone Company has sold its plant to W. D. Dunsmore, of Oskaloosa, Ia., and others. The new owners will make considerable improvement in the system.

FORT DODGE, IA.—The Newton & Northwestern Railway Company acquired the property of the Fort Dodge Street Railway January 31. The purchase includes the rolling stock and franchise. The price was $70,000.

CEDAR RAPIDS, IA.—The Albia & Centerville Railroad, between Albia and Centerville, is to be converted into an electric line and will connect with the present city lines at Centerville. The line will also be extended through Albia to Buxton and branches will be built to Mystic and Hiteman.

SIOUX CITY, IA.—The board of directors of the New State Telephone Company at the recent annual meeting voted to issue $100,000 worth of securities, as common and preferred stock, for improvements and extensions in its toll service. Work on the improvements will begin at once. They will include a trunk line to Council Bluffs and South Omaha, through lines to Sioux Falls, Yankton and Elk Point, a line to Worthington, Minn., to connect with the Tri-State Company's line from Minneapolis, and an extension from Randolph to Lincoln, Neb. The exchanges of the New State Company will undergo extensive improvements wherever they are needed. At Cherokee a new switchboard and copper circuit will be installed.

WYNNEWOOD, I. T.—It is stated that bids will be received until February 14 for constructing a combination water works and electric light system. J. O. Swingley is Mayor.

OTTAWA, KAN.—The Ottawa Telephone Company is to spend between $30,000 and $40,000 in improving its plant at Ottawa.

PITTSBURG, KAN.—The Pittsburg Railway and Light Company, Pittsburg, Kan., many of whose stockholders are Carthage (Mo.) capitalists, has recently purchased a 22x36-in. Reynolds Corliss engine, suited for left-hand drive, and a 300-kw engine type, direct-current generator for the enlargement of the present plant. The new unit will be furnished by the Allis-Chalmers Company, Milwaukee.

HOPKINSVILLE, KY.—Hilliard M. Dalton is reported to have purchased a franchise for a street railway and electric light plant.

CLOVERPORT, KY.—D. Stewart Miller, Jr., of Owensboro, has petitioned for a franchise to construct and operate an electric light plant.

MT. STERLING, KY.—The Mt. Sterling Water & Light Company is contemplating extensive improvements this coming season. A new plant will be installed and new street arc lamps will also be put in.

LAFAYETTE, LA.—An appropriation of $35,000 has been made for the purpose of making improvements in the water works system and the electric light plant.

WINFIELD, LA.—The Town Council has granted a franchise to the Winfield Electric Light & Power Company, Ltd., to establish an electric light and power plant in the town.

DEXTER, ME.—Mr. Charles H. Batchelder, the local builder and contractor, has been awarded the contract for building the new electric power plant.

LEWISTON, ME.—One of the latest enterprises in the telephone field is the Lewiston, Greene & Monmouth Telephone Company. It is said to have planned to build and maintain a system which will operate in various cities and towns in Androscoggin and Kennebec counties. The capital stock of the corporation is $10,000. The officers of the corporation are: President, R. Alden, of Winthrop; treasurer, H. M. Blake, of Monmouth; directors, R. Alden, Eli Hodgkins, A. H. Bailey, H. M. Blake, J. H. Gilman and H. E. Foster.

BALTIMORE, MD.—The directors of the Maryland Telephone Company met recently, and it is understood that they are planning to refinance the company in order to provide for the proposed installation of an automatic exchange system.

CUMBERLAND, MD.—J. A. McHenry, secretary and treasurer of the Cumberland & Mt. Savage Railway Company of Allegheny County, says the company has been incorporated and has obtained a valuable franchise to build its road on the public highway, 8 miles. No organization has been effected as yet.

LAWRENCE, MASS.—The Lawrence Gas Company, having reached the limit of $1,000,000 allowed under the statutes, has petitioned to be allowed to increase its capital stock to meet the growing demands for gas and electricity in Lawrence, Andover, Methuen and North Andover.

PITTSFIELD, MASS.—The International Power Company has received orders for four of the largest size Diesel engines. Two of them are to go to the Pittsfield, Mass., Electric Light Company. Manager Hughes, of the New England Telephone & Telegraph Company, has arranged to install 40 interior stations in the plant of the Stanley Electric Manufacturing Company.

HOLBROOK, MASS.—At a special meeting for the purpose of hearing the report of the committee chosen to ascertain the cost of lighting the town by electricity, Mr. McLaughlin, in behalf of the committee, stated that the only company available that they could do business with was the Randolph & Holbrook Electric Light & Power Company. That company would light the town with six arc lamps and 125 candle-power incandescent lamps for $2,000 per annum and for a term of five years.

FALL RIVER, MASS.—The contract between the city and the electric light company expires in October, 1907, and the company apparently does not fear any diminution of its business with the city. General plans and specifications for the foundation work of the proposed big new generating station at the foot of Hathaway Street have been given out and the specifications for the building itself will shortly follow. It is proposed to erect an entirely fireproof structure of steel, brick and cement, 120x120 feet in dimensions and from 50 to 75 feet in height.

NEW BEDFORD, MASS.—The State Board of Gas and Electric Light Commissioners are considering a petition presented by a committee of the Board of Trade for a reduction in the price of gas and electricity in this city and Fairhaven. It is claimed that the company can afford to supply gas at $1 per thousand cubic feet, with 10 per cent off for payment within ten days, and that 15 cents per kilowatt-hour should be the cost of electricity. The present rates are $1.10 with a discount of 10 per cent for gas, and 18 cents per kilowatt-hour for electricity, with a discount proportional to the amount used.

WORCESTER, MASS.—The New England Telephone & Telegraph Company on account of its increased business, finds it necessary to make arrangements for larger quarters. Negotiations are under way for the purchase of a piece of land adjoining the company's present exchange, and if this is secured the company proposes to erect a building as large as that now in use to provide for future expansion. If the adjoining land cannot be secured, the Telephone Company will establish a sub-exchange in some other part of the city. The company has recently been granted a franchise to establish a new main line between Adams and North Adams along the East Road from East Hoosac Street.

BROOKLINE, MASS.—At a special town meeting, on January 31, the town of Brookline, Mass., voted to appropriate $35,000 to erect a consolidated heating, lighting and power plant under the direction of the gymnasium and school committees to supply the Manual Training High School, the Municipal Bath House and the proposed gymnasium and high school. Early in the study of plans for the new gymnasium, which will cost $100,000, the question of heating and lighting came up. From the close proximity of the public bath house, the necessity of soon installing some steam laundry machinery in the latter and the large number of lamps that should be used in both buildings, it was evident that a considerable saving would be effected by a combined heating and lighting plant. It was found that the entire group of four buildings could be heated and lighted from one plant located partly in and partly behind the manual training building. By this arrangement one chimney would take the place of four, unnecessary duplication of parts would be eliminated, and several thousand dollars saved annually. It was decided not to install the heating plant in the gymnasium as first considered, on account of the expense and encroachment upon valuable space.

JACKSON, MICH.—The Michigan State Telephone Company is contemplating improvements this next year amounting to $200,000.

THREE RIVERS, MICH.—The Michigan & Indiana Traction Company has been granted a franchise by the City Council to operate an electric road through the city.

MUSKEGON, MICH.—Mayor Flemming proposes an easy plan for municipal ownership, whereby the old water works building might be equipped for a lighting plant at an expense not greater than $15,000.

WYANDOTTE, MICH.—The Pennsylvania Salt Mfg. Company, Wyandotte, Mich., with head offices in Philadelphia, has purchased a new power equipment to supplement the one already in use in order to meet the demands of increased business. The new units are a 36x48-in. simple, heavy-duty Reynolds Corliss engine, direct coupled to an 800-kw, direct-current Bullock generator. The engine will run in parallel with other units, and the load from the generator, which is of the engine type, will be used in part for light and power, but for the most part for electrolytic purposes. The entire unit, steam and electrical, will be furnished by the Allis-Chalmers Company, Milwaukee, and is to be ready for service early in June.

INTERNATIONAL FALLS, MINN.—E. W. Backus is said to be making arrangements to establish an electric light plant here.

DULUTH, MINN.—The Duluth General Electric Company has recently reorganized as the Duluth-Edison Electric Company, with a capital of $2,000,000. The company proposes to expend about $150,000 in changing from steam to water power.

CORINTH, MISS.—The Corinth & Shiloh Electric Railway Company proposes to construct an electric railway in Corinth. The company has a capital of $250,000.

CASSVILLE, MO.—The Cassville Mill & Supply Company is about to install a system of electric lighting for the city. The facilities of the company's present plant will be enlarged to meet the increased demand.

JEFFERSON CITY, MO.—Plans are being prepared by a local firm of architects for the construction of a new central light, heat and power plant for the penitentiary. The new plant will cost between $200,000 and $250,000.

CHILLICOTHE, MO.—At the election held January 29 for the purpose of deciding the question of bonding the city for $100,000 for the purpose of establishing its own water and light plant, the proposition carried 5 to 1. The city has been lighted by a private corporation for twenty years.

CLINTON, MO.—The Council has rejected the terms made recently by the Lighting Company and the Mayor has been investigating the conditions of the electric light plant at Harrisonville, with a view to gaining ideas for establishing a plant here, but no definite steps have been taken in the matter.

SEWARD, NEB.—The Seward Independent County Telephone Company is arranging to build a line from this point to Milford.

RED CLOUD, NEB.—Bonds have been voted, the proceeds of which will be utilized in installing an electric light plant for the town.

NASHUA, N. H.—Engineers are making surveys of the Nashua River bed in this city with a view, it is said, of establishing a large electric plant for the Jackson Manufacturing Company, to be operated by water power. It is also reported that a new dam may be constructed below the present structure.

ORANGE, N. J.—Bids willl be received until March 1 for lighting the streets of the city for a period of either three or five years. Address F. T. Crane, city engineer.

TRENTON, N. J.—A contract has been awarded by the New York-Philadelphia Company, operating the New York & Philadelphia electric railway by way of Trenton and Elizabeth, for building the second section of the proposed air line to the Schuykill Stone Company, of Philadelphia. This section extends from Rahway to Metuchen and will be double-tracked. Specifications for the third section between Metuchen and Milltown are being drafted and a contract will be awarded within a few weeks. The Atlantic City & Suburban Company, it is reported, contemplates extending its line from Somers Point to English Creek, along the Great Egg Harbor River road to May's Landing, across to Egg Harbor City and through to Tuckerton.

FARMINGTON, N. M.—The Sunshine Electric Power & Railway Company plans to build a large power plant at Fruitland, N. M., for the purpose of furnishing power and light and for operating an electric railway between Farmington and Jewett.

ROME, N. Y.—The Central New York & Empire State Telephone interests propose to spend $1,500,000 in the improvement of their system.

MONROE, N. Y.—There is some talk of the Sterling Lake Railroad being continued to Warwick and converted into an electric line.

FULTON, N. Y.—Louis W. Emerick has been granted a franchise in Fulton. He will organize a company which will install a modern telephone system.

TUPPER LAKE, N. Y.—The Robinson Telephone Company of Potsdam has been granted a franchise to build and operate a telephone system at Tupper Lake.

OSWEGO, N. Y.—It is announced that the extension of the Syracuse, Lakeside & Northern Railway from Phoenix to Fulton on the east side of the Seneca River, will be built in the spring.

NEW YORK, N. Y.—Bids will be received until February 13 by C. B. J. Snyder, Superintendent of School Buildings, for installing electrical equipment in the addition to School 71, borough of Manhattan; also an electric bell system in School 5, borough of Bronx.

WATERTOWN, N. Y.—The Public Works Committee on Street Lighting is considering plans for a new system of street lighting for the city. Three different plans are under discussion—one for straight electric lighting, one for straight gas lighting and the third for a combination of the other two.

BUFFALO, N. Y.—Henry J. Pierce, president of the International Traction Company, of Buffalo, says the steam railroad companies are planning to jointly build a staton at William and Curtis Streets, and that the New York Central proposes to electrify its belt line and establish convenient local passenger stations at different points, to which the International Company will loop its lines so as to handle traffic expeditiously. If the Union Station is established at William and Curtis Streets the International Traction Company undoubtedly will run belt lines to it direct from the Elmwood district, through Elmwood Avenue and Utica Street, via William Street, and back through Broadway, as well as belt lines from other parts of the city.

NEW YORK, N. Y.—The Great Eastern Telephone Company, a new independent concern in New York City, has made an application to open the streets to lay new subways under the franchise recently declared valid. D. A. Reynolds, president of the company, says: "We secured over 29,000 contracts for telephones during January, and now have more than 67,000 as the result of fourteen weeks' canvass. We have filed maps with the department for one exchange in lower Manhattan and one in the Bronx, which will be followed by others. Our orders for material will be placed at once upon receiving our permit."

TROY, N. Y.—The Hudson River Electric Light & Power Company, which is installing a series of plants in and around Fulton County, has purchased a piece of property between the cities of Johnstown and Gloversville, on which will be erected a sub-station to serve both places. The purchase includes the franchise of James H. Cross of Johnstown, which gives the company the desired privileges in that city. Application will be made at an early date for a franchise in Gloversville. The line will be a branch of the trunk line which extends from Spier Falls through Saratoga Springs and Ballston Spa to Troy, Albany and Schenectady. From the sub-station at Ballston Spa another line is being constructed, which will extend through the western territory of the company and will be known as the Utica line. This line will extend across country to Amsterdam and thence to Johnstown, Little Falls, Herkimer and Utica. The material is all on the ground for the line from Ballston Spa to Amsterdam. At the latter city a sub-station will be located on Church Street. The company proposes to furnish electricity in all the cities and villages along its route. The company secured the contract for furnishing power for The Utica & Mohawk Valley Railroad Company a year ago.

HAMILTON, OHIO.—The Hamilton Home Telephone Company expects to spend $35,000 in improving its system.

CANTON, OHIO.—Reports state that eastern capitalists are interested in a project to construct a new interurban road from Canton to Carroll.

GEORGETOWN, OHIO.—The City Clerk writes that the citizens voted January 29 to issue $15,000 bonds for the construction of an electric light plant.

TOLEDO, OHIO.—The Toledo & Columbus Railway Company is securing right of way between Fremont, Tiffin and Bucyrus. George D. Everett is in charge of the work.

LANCASTER, OHIO.—The Fairfield Traction Company is planning to build a line north to Buckeye Lake, giving Lancaster direct connection with that famous resort.

CHILLICOTHE, OHIO.—General Manager A. G. Moser, of the Chillicothe Electric Railroad, Light & Power Company, informs us that the company intends to rebuild all the outside overhead work.

EAST LIVERPOOL, OHIO.—The East Liverpool Traction & Light Company is planning to build an extension to Vanport, Pa., where connection will be made with an extension of the Pittsburg Railways Company.

ELYRIA, OHIO.—The Lake Shore Electric Railway Company will make extensive improvements in its lines this year. Part of them have already been planned in detail and orders placed, including a power plant which will cost about $60,000.

CLEVELAND, OHIO.—Farmers in the neighborhood of Berea and Elyria have submitted a proposition to the Cleveland & Southwestern Traction Company for the building of a new line from Berea through Olmstead Falls, Columbus and Eaton to Abbeys Corners, where it would connect with the Grafton spur line owned by this company

COLUMBUS, OHIO.—President John G. Webb, of the Columbus, Delaware & Marion Railway, announces that his company will make important extensions in the spring. The main line will be extended from Marion to Bucyrus, 21 miles; a spur will be run to Richwood, 6 miles and 3 miles of city track will be laid in Marion. The main line is to be double-tracked from Columbus to Glenmary Park, 12 miles. Two additional 2,000-kw Curtis turbines are to be placed in the main power station at Stratford.

WATONGA, OKLA.—G. E. Moore, City Clerk, writes that bids will be received until February 23 at his office for furnishing material and constructing complete an electric light plant and water main extension. M. A. Earl, 1416 First National Bank Building, Chicago, Ill., is the engineer.

SPRAY, ORE.—A movement has been started among the ranchers of the John Day River district for the installation of a local telephone system.

PORTLAND, ORE.—The Portland General Electric Company has secured the contract for lighting St. Johns, Ore., for a term of five years. A sub-station will probably be constructed at that point.

ALBANY, ORE.—George E. Pusey, who is believed to act for the Portland General Electric Company, has filed a claim in the county recorder's office for 100,000 miner's inches of the waters of the North Santiam River, above Mill City, where he owns land along that stream. He proposes to run five ditches out of the stream, the ditches to be 10 feet deep, 40 feet wide at the bottom and 70 feet at the top; in lieu of ditches he may use flumes 10 feet deep and 48 feet wide, or pipe lines, the pipe to be 11 feet in diameter. The purpose is to secure power for the purpose of generating electricity for light and power. The Santiam River above Mill City is said to be capable of developing 780,000 hp between Detroit and Mill City.

GETTYSBURG, PA.—The United Telephone & Telegraph Company is to entirely rebuild its system at this place.

WEST CHESTER, PA.—It is stated that the management of the Philadelphia, Coatesville & Lancaster Electric Railway Company expects to continue construction work in the spring and to have cars running at Atglen before the middle of the summer.

EASTON, PA.—Sealed proposals will be received at the office of the City Clerk until 4 p. m., Wednesday, February 14, for 250 series enclosed direct-current arc lamps. Address John Mutchler.

BUTLER, PA.—Superintendent Palmer, of the Butler Passenger Railway Company, has received orders to start work immediately on a 4,000-ft. extension of the company's lines through the Lyndora district.

YORK, PA.—The Dillsburg & Mechanicsburg Railroad, eight miles long, with a two-mile branch, was sold at public auction recently to the Cumberland Valley Railroad under the foreclosure of a mortgage of $100,000 held by the latter company. The purchase price was $50,000. The line has been operated for years by the Cumberland Valley Railroad Company. It will now be turned into an electric road.

ALLENTOWN, PA.—The Taylor Engineering Company, New York City, has recently purchased for the Taylor Manufacturing and Construction Company, Allentown, Pa., a 14x24-in. Reynolds Corliss engine, direct coupled to a 100-kw engine type "Bullock" generator, operating at 150 r.p.m. The new unit, which will be used for power and lighting purposes, will be furnished by the Allis-Chalmers Company, Milwaukee.

HARRISBURG, PA.—The Central Pennsylvania Traction Company, Harrisburg, Pa., recently contracted for three Reynolds horizontal, heavy-duty, cross-compound engines, cylinders 22x48 in. in diameter and 42-in. stroke, for direct connection to three 650-kw railway type generators, 600 volts. Both engines and generators will be furnished by the Allis-Chalmers Company, Milwaukee.

PHILADELPHIA, PA.—An ordinance is being prepared for presentation to the City Council by George R. Sheldon and Pliny Fisk, of New York, representing a strong group of capitalists, which proposes that the Commonwealth Electric Company shall be granted franchises satis-

factory to the city, enabling it to use the conduits of the Keystone Telephone Company and to do an electric lighting business in Philadelphia. The Mayor has appointed a sub-committee of his Advisory Committee to investigate the question. If this ordinance is passed, it will mean competition for the Philadelphia Electric Company, which has had a monopoly of the lighting in Philadelphia for years.

PIERRE, S. D.—The City Council of Fort Pierre has granted the franchise asked for by Messrs. Newbanks and Fischer for the right to build and operate a street railway.

MILBANK, S. D.—The Grant County Telephone Company is to spend $30,000 in extending and improving its system.

SIOUX FALLS, S. D.—The Sioux Falls Interurban Electric Railroad Company, which was recently incorporated, announces that the funds necessary to construct the road have been raised and that work will begin as soon as the snow is off the ground.

BELLE FOURCHE, S. D.—The Belle Fourche Electric Light, Heat & Power Company, Belle Fourche, S. D., has recently placed orders with the Allis-Chalmers Company, Milwaukee, for extensive new equipment for the company's plant. The new machinery to be installed will consist of a 16x42-in. heavy-duty Reynolds Corliss engine, adapted for right-hand drive; two new 66x16-ft. Chandler & Taylor boilers, duplex feed pumps, feed water heater, etc. The new engine will be belted to a countershaft to drive a 150-kw alternator, the load being practically all used for lighting purposes. Mr. A. A. Noodie, paymaster of the Homestake Mining Company, is president of the company, and Mr. J. S. Moodie, general manager of the Belle Fourche Power & Water Company, is vice-president.

PIERRE, S. D.—W. H. Rowe has petitioned for a franchise, and if granted same, will construct an electric light plant here at a cost of $10,000 to $15,000.

DAYTON, TENN.—Mr. W. G. Holman, the superintendent of the Rhea County Electric Light Company, informs us that it bought out the Dayton Light & Power Company recently. The management intends during the next sixty day to tear out the present machinery consisting of a high speed Frick engine and a 50-kw Wood alternator, and to replace them with a 150-hp Corliss engine and a 100-kw, 2,300-volt, 60-cycle, single-phase generator. The present plant has become too small to carry the load that has to be handled.

DALLAS, TEX.—The Southwestern Telegraph & Telephone Company is contemplating establishing a telephone exchange in South Dallas in a few months.

AUSTIN, TEX.—Stone & Webster, of Boston, are said to have sent Mayor Shelley a report on rebuilding the Austin dam. It calls for an expenditure of $555,200 in replacing the dam, and $186,800 for rehabilitating and equipping the power plant.

HOUSTON, TEX.—F. L. Dana, secretary of the Houston-Galveston Interurban Electric Railway Company, says that work will begin within thirty days on the company's line to connect Houston and Galveston, 48 miles distant. In addition to this, a line will be built at La Porte, 12 miles. The power station and repair shops will be located at Genoa. The company will furnish power for lighting purposes also.

MONTPELIER, VT.—A special meeting of the Board of Directors of the Consolidated Lighting Company has been held, at which time it was voted to make extensions to the system which will amount in the neighborhood of $100,000. A new building will be constructed at Bolton Falls and other improvements made, including a new switchboard to cost $10,000. The company has in the neighborhood of 50 stone sheds employing 2,000 or more men depending on it for power, and to insure power at all times this large increase in the company's plant is made. Additional water wheels will be put in the Bolton Falls plant and will increase the capacity of that plant from 2,000 to 4,200 horse-power, which, with the 3,000 at the Pioneer plant, will give 7,200 horse-power.

SPOKANE, WASH.—The Inland Empire Railway Company, which was recently organized here with a capital of $20,000,000, is making plans to build an electric road from Spokane to Phoenix, B. C.

GOLDENDALE, WASH.—The County Commissioners have granted permission to the Eastern Klickitat Telephone Company to erect and maintain a telephone system along the public highways of Klickitat County.

GOLDENDALE, WASH.—The Goldendale Telephone & Telegraph Company has decided to make several improvements in its system. A new switchboard will be installed and several new farmers' lines will be built.

FAIRMOUNT, W. VA.—A contract has been signed for work to begin soon on the Fairmount & Mannington Railroad Company's line. The company will purchase and take over the Mannington light and power plant and a small railroad about a mile long. In all, the company will build 14½ miles of line. Thomas W. Fleming is president of the company.

SHEBOYGAN, WIS.—The Citizens' Telephone Company, of Sheboygan, is to spend $30,000 in improving its system.

LETHBRIDGE, ALB., CAN.—The Lethbridge Electric Light Company will erect a new building and make extensive improvements in its plant.

FORT STEELE, B. C.—The Bull River Power, Light & Mining Company will start construction on a lighting plant for this town as soon as weather permits in the spring.

INDIAN HEAD, CAN.—The town is seeking authority to borrow $100,000 for a municipal lighting plant. Address J. A. McCaul.

CARBERRY, MAN.—The Council is considering plans for a municipal electric lighting plant. Address Mayor Eaton.

WINNIPEG, MAN.—The Canadian Pacific Railroad Telegraph Company has made an appropriation of $250,000 to be used in improvements to its lines in the Northwest during the coming summer.

WINNIPEG, MAN.—Work will be commenced on the construction of the civic lighting and power plant at Lac du Bonnet as soon as weather permits in the spring. The power will be transmitted over 60 miles from the falls to the city.

YEBABITO, MEX.—The Sinaloa Land Company will install an electric light plant and telephone system at Yebabito.

COLONIA JUAREZ, MEX.—The Mormon colonists of Colonia Juarez have taken steps towards installing an electric light plant for the town.

CHIHUAHUA, MEX.—The Compania Industrial Mexicana, which operates an electric light and power plant at Chihuahua, is preparing to increase the capacity of its plant.

PARRAL, MEX.—The Veta Colorado Mining and Smelting Company will install an electric power plant for the purpose of operating the machinery of its mines. H. R. Gardner is chief electrician for the company.

CITY OF MEXICO, MEX.—Eduardo Vinas, of the City of Mexico, is arranging to establish a hydro-electric plant near the city. He is said to be representing Miguel Cervantes y Estanillo in promoting the enterprise. The waters of the Xalapango and Papalota Rivers will be used for generating the electrical power.

CHIHUAHUA, MEX.—The Municipal Government of Chihuahua, aided by the State Government, has under consideration the installation of a large electric power plant at the proposed great dam that is to be built across the river near town.

JALAPA, MEX.—Angus H. McLean, of Jalapa, has made application to the Federal Government for a concession to install an electric power plant near here. The water of the Grande Misantle River will be used to furnish power. Transmission lines will be built to the principal towns and industrial centers of the district.

CITY OF MEXICO, MEX.—The Mexican Light and Power Company, of the City of Mexico, is still having trouble with bold thieves who do not hesitate to cut and carry off sections of the transmission cable which runs from Necaxa to the city. Recently this cable was cut and portions of it, which weighed 1,500 pounds, were carried away by the thieves. The theft caused a serious interruption of the services of the company. Efforts are being made to apprehend the thieves.

PARRAL, MEX.—Mr. Rodriguez, head of the well-known mining company of Ignacio Rodriguez Ramos, has been given a sixty-day option on a federal concession to develop the water power of the Conchos River in the State of Chihuahua, which was issued by the Federal government several months ago to Paul Tuinter and Joaquin Cotazar, Jr. In about a month a report will be completed as to the feasibility of the project. If the engineers report favorably, it is said that Mr. Rodriguez will at once take steps to organize a company with a capital of $5,000,000 for operating the concession and furnishing electricity to the whole of the State of Chihuahua. It is said that the site is capable of developing 25,000 hp.

GRAND FALLS, N. B.—The Grand Falls Power Company, which is proposing to develop the water power at Grand Falls, N. B., for the purpose of generating electrical power, has forwarded plans and specifications to Ottawa and is awaiting the approval of the Governor-General in council. It is understood that as soon as the documents have been passed work will be commenced. The company proposes to construct a concrete dam at a point 750 feet above the falls across a narrow part of the river. It will be 28 feet high and 540 feet long between abutments and founded on solid rock.

GODERICH, ONT.—A dam, costing $250,000 and capable of developing 2,575 hp, is to be built across the Maitland River about four miles from here. The work will be commenced in a few months. The power will be used not only for industrial purposes, but will also operate the town's water and lighting plant and probably a system of railway.

SHERBROOKE, QUE.—At the annual meeting of the Sherbrooke Power, Light & Heat Company the directors' report showed a substantial increase in business in the electric lighting department. The report also stated that extensive improvements to the power house and plant are contemplated, which, when completed, will give the company a large reserve of power with which to meet the steadily increasing demands for its services.

New Incorporations.

OZARK, ARK.—The Ozark & St. Paul Telephone Company has been incorporated with a capital stock of $5,000. The incorporators are: C. B. Blaylock, Joseph Hill, S. Davis, J. A. Bateman, L. G. Bristow and other well-known business men.

QUINCY, CAL.—The Northern Sierra Power Company has filed articles of incorporation, showing a capital stock of $1,500,000. Among the incorporators are C. H. Goodhue, J. G. Niggle and C. F. Phelan.

NORWICH, CONN.—Former State Treasurer Henry H. Gallup and E. W. Jackson, of Norwich, and William Segar and James M. Pendleton, of

Westerly, R. I., are the incorporators named in a resolution which is now pending before the Rhode Island Legislature, and which grants a charter to the Westerly & Connecticut Railway Company. The proposed corporation has an authorized capital stock of $400,000. The Norwich & Westerly Company is authorized to build an electric railway from Norwich to the Connecticut State boundary at Westerly.

BOISE, IDA.—The Idaho Telephone Company has been incorporated with a capital of $5,000. The company's headquarters will be at Rupert, Idaho. The incorporators are Marion Mackey, Alice Mackey, Llouellyn M. Zug, Ailie D. Ash and Frank Copening. Construction will commence at once, part of the material having already been ordered.

CHICAGO, ILL.—The Ottawa & Streator Power, Light & Traction Company has filed articles of incorporation, with a capital stock of $50,000. Among the incorporators are M. Thorne, William E. McLean and M. W. Kelly.

PALOMA, ILL.—The Central Exchange Telephone Company, of Gilmer Township, capital $2,500, has been formed. Incorporators: J. R. Henry, O. H. Lawiess and J. Dickhut.

BELVIDERE, ILL.—The Belvidere, De Kalb & Southern Railway Company has filed articles of incorporation and been granted a charter. The company will construct a railway from the northern line of McHenry County to Joliet. The principal offices of the company, which is capitalized at $1,500,000, will be in Chicago. The incorporators and first board of directors are: W. H. Zimmerman, J. B. Huling, J. D. Harvey, J. C. Williams and Millard R. Powers.

FORTVILLE, IND.—The Fortville Electric Company has been organized and will construct an electric light plant here.

CRANDALL, IND.—The Crandall Telephone Company has been incorporated and will soon ask for bids for the construction of a telephone plant here.

CRANDALL, IND.—The Excelsior Telephone Company, with a capital of $6,000, has been incorporated by W. E. Yenawine, B. F. Markwell and others.

EVANSVILLE, IND.—The Citizens' Telephone Company has filed its articles of incorporation and will apply at once for a franchise to erect an exchange here at a cost of from $300,000 to $400,000. The company will make connections with all the independent lines in Southern Indiana.

TOCSIN, IND.—The Tocsin Telephone Company has filed articles of incorporation. The company is capitalized at $10,000, and will operate in the northern part of Wells County, with home office in Tocsin. It takes over the business of a partnership having a large number of telephones in the territory. Extensions will be made and new equipment installed in the exchange.

INDIANAPOLIS, IND.—Articles of incorporation have been filed by the United Traction Coal Company, with headquarters in this city. The capital stock is $300,000. The company has leased coal lands in Green and Sullivan Counties, soon to be reached by interurban lines, and will sink shafts and make provisions for transporting the product. The directors are J. V. Van Osdell, William Sampson, H. C. Carpenter and C. H. Allen.

RICK VALLEY, IA.—The Klein Rural Telephone Company has been incorporated by J. E. Quintan and others, with a capital stock of $2,000.

DES MOINES, IA.—Articles of incorporation of the Indianola Interurban Railway Company have been filed with the Secretary of State. Des Moines is made the principal place of business and the capital stock is fixed temporarily at $50,000.

BURRTON, KAN.—The Burrton-Inman Telephone Company was recently incorporated with a capital of $12,000.

HOXIE, KAN.—The Hoxie-Northwestern Telephone Company is the name of a recently incorporated concern with a capital of $1,200.

MENLO, KAN.—A telephone company, with a capital of $2,200, was recently incorporated under the title of the Farmers' Mutual Telephone Company.

POMONA, KAN.—An Independent telephone company has been organized at Pomona, and the following temporary officers elected: E. G. Swayze, president; F. E. Dyer, secretary and treasurer; Fred Baldwin and Carl Hoopes, executive committee.

BERNICE, LA.—The Bernice Telephone Company, Ltd., has been incorporated with a capital stock of $5,000. W. H. Wise is president; L. N. Holmes, vice-president; S. J. Beaird, secretary and treasurer.

JESSIE, MICH.—The Farmers' Telephone Company has been organized at Shepardsville, with a capital of $1,000, all subscribed.

SEDAN, MINN.—Articles of incorporation have been filed by William Wolfe, Henry Hess, W. E. Martin, A. Woodhall and M. C. Whitney. The company is capitalized at $2,000.

HALLAM, NEB.—D. W. Sherwood and others have incorporated the Star Telephone Company with a capital of $1,440.

ALBANY, N. Y.—The Fishers Island Railroad Company has been incorporated with a capital of $12,000, to operate a cable or electric railway on Fishers Island, Suffolk County. The directors are Walton Ferguson, A. L. Ferguson, of New York, and Frank N. Hein, of Fishers Island.

BUFFALO, N. Y.—The Buffalo Subway Railroad Company has been incorporated to construct an underground electric railway eight miles long in Erie County. The company has a capital of $1,000,000, and the following are the directors: Frank S. McGraw, A. W. Bonynge, Edward McInnes and H. M. Spencer.

OSSINING, N. Y.—The Hudson River & Eastern Traction Company has been organized and incorporated to operate an electric railway nine miles long from a connection with the New York Central Railroad in Ossining through Briar Bluff Manor, Pleasantville and Sherman Park. The company is capitalized at $400,000, and the following named gentlemen comprise the first board of directors: Ashley T. Cole, Arthur McConsland, Peter C. Schutrum and Howard E. Keeler.

NEW LEXINGTON, OHIO.—The Citizens' Independent Telephone Company has been incorporated with a capital of $50,000.

CARR, OKLA.—The Carr Gin, Milling & Telephone Company, having a capital stock of $6,000, has filed articles of incorporation.

ESCATADA, ORE.—The Escatada Light & Power Company, having a capital of $3,000, has been incorporated by George F. Martin, W. M. Brewster and W. T. Muir.

FOREST GROVE, ORE.—The Forest Grove Transportation Company, which recently obtained a franchise to build and operate an electric railway from the depot to the business part of the city, has filed articles of incorporation. The incorporators are Mrs. A. F. Rogers. E. W. Haines, George Hancock, John Templeton, George F. Naylor, F. A. Watrous and J. E. Loomis.

FRIEND'S COVE, PA.—The citizens have organized the Friend's Cove Mutual Telephone Company, with the following officers: Samuel Hunt, president; Clayton Smith, vice-president; S. F. Whetstone, secretary; John Whetstone, treasurer. Connections will be made with the rest of the country through the Bell Company and the County Telephone Company.

ANDERSON, S. C.—The Savannah River Power Company has been organized and the following officers elected: H. A. Orr, president; C. Elmer Smith, of York, Pa., vice-president; S. M. Orr, treasurer, and E. K. Chapman, secretary. The other directors are H. H. Watkins and J. E. Sirrine. This is the million-dollar company, which will develop electric power on the Savannah River, and bring it to this place. Actual work will begin as soon as details can be arranged.

HOT SPRING, S. D.—The Fall River Telephone Company has been incorporated with a capital of $30,000. The company will operate principally in Fall River County, with headquarters at Hot Springs. The incorporators are D. O. Kimball, Jacob Burg, W. C. Timma and Thomas Getty, all of this place.

PIERRE, S. D.—Articles of incorporation have been filed by the Langford Telephone Company, at Langford, with a capital of $22,500. The company will do a general telephone business in the counties of Marshall, Day, Brown and Roberts. The incorporators are C. A. Platt, J. F. D. Cook, Howard Platt, C. B. Hersey, W. H. Sherrard and others at Langford.

NASHVILLE, TENN.—A charter has been granted to the Home Telegraph Company, which was incorporated for the purpose of constructing a telegraph line from Franklin to Goodlettsville. The company has a capital stock of $10,000 and the following are named as incorporators: R. E. Cooper, W. C. Polk, L. S. Miller, Louis Dupont and Luke Lea.

GROVETON, TEX.—The Groveton Light & Power Company has been incorporated, with a capital of $15,000, by John R. Collins, A. J. Wood, C. H. Kenley and others.

HOUSTON, TEX.—The Houston Lighting & Power Company has been reorganized and articles of incorporation filed. The company's capital is $1,000,000. It will take over, improve and operate an established plant.

PECOS CITY, TEX.—The Reeves County Telephone Company, with a capital stock of $20,000, has been incorporated by C. W. Kelley, R. S. Johnson, R. G. Sage, F. W. Johnson, W. D. Cowan and G. B. Laudman.

EL CAMPO, TEX.—A stock company has been organized here with $15,000 fully paid in capital to install an electric light, ice and water plant at this place. The following officers have been elected: E. L. Correll, president; Frank Koenig, Jr., vice-president and general manager; J. W. Leach, secretary and treasurer. The electric light plant formerly operated by E. L. Correll has been purchased by the new company and will continue to furnish light until the new company can be installed.

LURAY, VA.—The Shenandoah River Light & Power Corporation has filed its articles of incorporation, with the following officers: T. J. Berry, president; C. S. Landram, vice-president; John W. Grove, secretary and treasurer, all of Luray. The minimum capital stock is stated as $20,000 and the maximum amount is placed at $50,000. The company will construct a dam and a power plant for the generation of electricity.

TACOMA, WASH.—The Home Telephone Company, of Puget Sound, has filed articles of incorporation, showing a capital stock of $5,000,000. Edward E. Webster and Charles E. Sumner are among those interested.

MILWAUKEE, WIS.—Articles of incorporation have been filed for the Chicago & Milwaukee Electric Railway Company by J. H. Marchutz, J. C. Stevens and L. Quarries. The capital is $100,000.

EASTMAN, WIS.—The Western Crawford County Farmers' Telephone Company, Eastman, has been organized. Incorporators: James Fisher, J. F. Maney, J. R. Maney, G. H. Harvat and M. Lennehan.

NORTH MILWAUKEE, WIS.—The North Milwaukee Light & Power Company has been incorporated with a capital stock of $50,000. Dr. J. Thiemann, J. J. Schissler and P. V. Schissler are the incorporators.

MONTREAL, QUE.—The Central Heat, Light & Power Company, Ltd., has been incorporated, with a capital stock of $500,000. Its chief place of business will be in Montreal. It will conduct a light, heat and power business in all its branches.

New Industrial Companies.

THE CHEROKEE ELECTRIC & MANUFACTURING COMPANY has been incorporated at Cherokee, Okla., with a capital stock of $16,000.

THE UNITED ELECTRIC & APPARATUS COMPANY, of Boston, Mass., has been formed; capital, $25,000, by J. McCloskey, Wm. H. Knight and J. H. Dorman.

OREGON ELECTRIC FINANCE COMPANY, of Brooklyn, has recently been incorporated to conduct a general trust and fiduciary business. The company's capital is $2,000.

HIGH-SPEED ELECTRIC COMPANY, New York, has filed articles of incorporation, with a capital stock of $58,000. Leswig Zeisler, H. Schwarz and E. V. Miller are named as directors.

ATLAS ELECTRIC COMPANY, Chicago, Ill., has been incorporated by H. G. Hill, S. H. Meyers and James C. Hood. The company has a capital of $2,500 and will do a manufacturing business.

UNITED STATES ELECTRIC PROTECTION & CONSTRUCTION COMPANY, of New York, has filed articles of incorporation. Its capital is $30,000, and the following are the directors: G. M. Treiber, R. C. Bennett and C. F. Bruckner.

THE RUSSELL ELECTRIC COMPANY, Danbury, Conn., has been incorporated by William E. Russell and others, of this city. The company has a capital of $20,000. It will engage in the manufacture of electric toys, medical batteries, telephones and electric bells.

HORTO ELECTRIC COMPANY, Chicago, Ill., has filed articles of incorporation and will engage in the manufacture of electrical appliances. The company has a capital of $10,000 and was incorporated by Benjamin C. Bachrach, Benson Landon and Henry A. Berger.

THE F. P. MORRISON ELECTRIC & MANUFACTURING COMPANY, of New York, has been incorporated with a capital of $5,000, and will engage in a general electrical contracting business. F. P. Morrison, W. H. Morrison and O. J. Morrison are the directors.

THE J. W. LATHROP COMPANY, INC., of Groton, Conn., has filed a certificate of incorporation. It has a capital stock of $10,000 and will engage in the manufacture and sale of engines and conduct a general machine business. The incorporators are James W. Lathrop, Edgar A. Rathbun and Elsie M. Lathrop.

THE ELECTRIC MACHINERY COMPANY, Chattanooga, Tenn., has been recently organized here. John Pruiss, an electrical engineer of Germany, will be manager of the new concern. Mr. Pruiss and A. W. Lehmann, Sr., have applied for a patent for a simple system of underground electric railway conduits, which will be manufactured and marketed by the company. The new company will also deal in all kinds of electrical machinery.

THE ELECTRICAL CONSTRUCTION COMPANY, of St. Louis, has been incorporated with a capital stock of $125,000. The stockholders are Arthur W. Lambert, Max Koehler, trustee for Hugo A. Koehler, C. Marquand Forster, S. B. Jeffries, Edward A. Faust, Max Koehler, Jesse W. Barrell and James S. Brailey, Jr. The object of the company is to construct telephone and electric light and power plants and to manufacture and deal in electrical instruments and equipment used in such plants.

THE F. P. HARRISON ELECTRIC & MANUFACTURING COMPANY, New York, N. Y., has recently been organized, having taken over and absorbed McLear & Co., of the same city. It has a well-equipped shop for the manufacture of armature coils and rewinding of armatures. The company will also do a general railway supply business and will carry a line of such supplies and specialties as are needed in electrical construction work. The officers of the company are: F. P. Harrison, president and treasurer; W. H. Harrison, secretary; A. E. Meixell, vice-president and general manager.

Legal.

STORAGE BATTERY LITIGATION.—The Electric Storage Battery Company has filed papers in a suit against the Universal Storage Battery Company, manufacturer of the Morrison battery, claiming $50,000 damages for infringing the Knowles patent, owned by the Electric Storage Battery Company. Suit has been brought in Wilmington, Del., the Universal Storage Battery Company being a Delaware corporation.

SUDDEN VALUE FOR STOCK.—Last week in this city, Judge Holt of the United States District Court reopened the bankruptcy case of William J. Griffiths and appointed Frederick B. Campbell receiver with a bond of $3,000. The reopening of the case was occasioned by the discovery that some shares of telephone stock which were inventoried as of no value are worth more than $6,500. Mr. Griffiths filed a petition in bankruptcy on April 1, 1904, and received his discharge on May 16, 1904. There were only two creditors, the Guaranty Trust Company, $6,257, and Elizabeth Griffiths, mother of the bankrupt, $5,320. Mr. Campbell was appointed trustee, but no assets came into his possession. It now appears that 115 shares of stock of the New York and Eastern Telegraph and Telephone Company belonging to Mr. Griffiths are held by the Hamilton Trust Company in escrow and Adam Frank, attorney for Mr. Griffiths, has found a purchaser for this stock at $56.75 per share, amounting to $6,526.25. The purchaser is Reon Barnes. Mr. Campbell is authorized to sell the stock and to pay Mr. Frank half the proceeds as compensation for bringing about the sale. The receiver is also authorized to sell 25 more shares of the stock formerly standing in the name of Abraham Norden and to pay the proceeds to Mr. Norden. It is said that a majority of the stock is now owned by the Coast Line Telephone Company.

Obituary.

MR. HENRY T. HOPPE, a well known citizen of Richmond, Va., died recently at the Virginia Hospital in that city. Mr. Hoppe was for a number of years general superintendent of the Virginia Passenger & Power Company, and at the time of his death was identified with a number of enterprises in Richmond, among which was the Citizens' Rapid Transit Company. He was 40 years old, and is survived by a widow and four children.

MR. F. T. TOWNE.—We regret to note that Mr. Frederick T. Towne, younger son of Henry R. Towne, of New York, President of the Yale & Towne Manufacturing Company, died of Bright's disease at Stamford, Conn. Mr. Towne was general superintendent of the company's plant there. In the afternoon he addressed the employes and made the semi-annual distribution of the $1,200 offered yearly by the company for suggestions calculated to be of mutual benefit. He fainted a few minutes after finishing his address. Mrs. Towne, who was at the factory for the ceremony, hurried him home in a carriage, but he never regained consciousness. The widow was Miss Constance Gibbons, daughter of William T. Gibbons, of Wilmington, Del. There are two children. Mr. Towne was a member of the Engineer's Club of New York, the Weeburn Golf Club and the Suburban Club of Stamford. He was a graduate of Tufts College. It was his ambition to make the Yale & Towne plant an ideal factory from the standpoint of the employed as well as the employers.

Educational.

TELEPHONE ENGINEERING AT ARMOUR.—By some unaccountable slip the notes on the Chicago Electrical Show in our issue of Jan. 27 mentioned the telephone engineering work at Armour Institute of Technology as being under Professor Kelsey, whereas, as is well known, this work at Armour is carried on by Prof. G. W. Wilder, Prof. Kelsey being of Purdue University.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—A remarkable series of photographs of the canals on the planet Mars is on exhibition at the Massachusetts Institute of Technology. The work was done by Mr. C. O. Lampard, of the Lowell Observatory, at Flagstaff, Arizona, and the photographs are the first which have ever been successfully taken of this subject. The Martian Canals have been studied for over twenty years at Flagstaff, but until recently the only illustrations available have been made from observers' drawings. The photographs were taken with a 24-inch telescope whose feature had been diaphragmed down to 12 inches, the plates being very fine grained. The exposures varied from 4 to 10 seconds; a special Wallace colored screen was used for sifting all the rays of light except those which could be focused on the plate, and an astronomical clock of great accuracy was used for following the planets' motion. The exhibit is beautifully illuminated by eleven 16-cp incandescent lamps of the bunghole type, spaced around three sides of a concave frame lined on the interior with a reflecting surface. From 12 to 15 cp per sq. ft. is a rough estimate of the brilliancy of the illumination, which is even more effective when the photographs are exhibited as transparencies. Electricity doubtless also played an important part in the securing of the photographs at the Observatory.

Personal.

MR. ANDRES HORCASITAS has resigned his position as Government inspector of electric light plants in Mexico.

MR. C. H. BEDELL, of the Electro-Dynamic Company, read a paper January 23, at the Modern Science Club, Brooklyn, before the Association of Steam Engineers, on variable speed motors.

MR. H. E. RYDER.—Mr. Hurbert E. Ryder, superintendent of the Marlboro Electric Light Company, has been appointed assistant superintendent of the Fall River Electric Light Company, Fall River, Mass.

MR. FRANK H. FOOTE has been appointed general manager of the Vermont Power & Manufacturing Company and of the St. Albans Street Railway Company, succeeding Mr. W. H. Vorce, who recently resigned, as noted elsewhere in this column.

MR. ALEX. DOW, vice-president of the Detroit Edison and Peninsular Electric Light Companies, has sailed with Mrs. Dow this week for England, to take two or three months of vacation. Virtually the whole time will be spent quietly in one of the old cathedral cities.

MR. HENRY FLOY returned last week from a month's absence in Mexico, where he went to investigate and report on a 50,000-hp proposed hydro-electric development and a 100-mile transmission. The prospects are that the work of installation will be undertaken in the near future.

MR. WILLIAM B. WOODBURY has resigned as assistant general manager of the Cuyahoga Telephone Company, of Cleveland, Ohio, and on February 15, will take charge of the Co-operative Telephone Company in Detroit, Mich., which has been bought by the Kaeler-Brailey syndicate.

Mr. FRANK N. JEWETT has been made district manager for the Wagner Electric Manufacturing Company for the states of Minnesota, Wisconsin, eastern Iowa, northern Illinois and Indiana, and northern and western Michigan, with offices at 1623-1624 Marquette Building, Cnicago, Illinois.

MR. R. L. DONALD.—The firm of Barstow & Chambers, consulting electrical engineers of Portland, Ore., and New York City, have just added Mr. R. L. Donald to their staff. He is a resident engineer of the Southern Pacific and will have charge of all roadbed construction for the firm.

MAJ.-GEN. A. E. BLISS, who has been for many years general superintendent of the Malden Electric Company, Malden, Mass., has now been made general superintendent of the Malden & Melrose Gas Light Company, the Suburban Gas & Electric Company, the Haverhill Electric Company, and the Springfield Gas Company.

MR. W. A. SHARP, of Tacoma, Wash., has resigned as assistant superintendent of the Seattle-Tacoma Interurban Railway to accept the superintendency of the Montana Miners' Electric Railway & Power Company, which is building an electric railway from Libby, Mont., for a distance of 25 miles into the Cœur d'Alene mining district.

MR. WM. T. DEAN, for the past four and a half years chief electrician for the Illinois Steel Company, of South Chicago, Ill., resigned February 15 to enter the service of the General Electric Company. He will devote his time to the iron and steel industry in the Chicago district, where a large amount of electrical apparatus is required constantly.

MR. P. N. NUNN, chief engineer of the Niagara Power Company, has sailed this week on the Clark winter cruise steamer "Arabic," accompanied by Mrs. Nunn, with the intention of taking rest and recreation for several weeks in this agreeable manner. Before leaving Niagara Mr. Nunn was able to take a share in receiving and entertaining the Canadian Society of Civil Engineers.

MR. WILLIAM L. CLARKE, formerly superintendent of the Atlantic Coast Electric Light Company, of Asbury Park, N. J., has severed his connection as general manager of the United Gas, Electric Light & Fuel Company, of Sandy Hill, N. Y., to accept the general managership of the Citizens' Electric Light, Heat & Power Company, of Paris, Ill. He entered upon his new duties February 2.

MR. W. N. CLIFFORD, who for the past two years has filled the position of New England sales manager for the Shepherd Engineering Company, has resigned his position and accepted a similar one for the Russell Engine Company, of Massillon, O., which has opened an office at 141 Milk St., Boston, Mass. The Russell Engine Company manufactures engines for every service, high and low speed, single and four-valve types, direct connected or belted.

MR. H. H. VREELAND.—The welfare department of the National Civic Federation has issued the admirable address delivered by Mr. Vreeland, the chairman of the department, at the meeting of the New England Cotton Manufacturers' Association at Atlantic City last year. He spoke as one who had had 15,000 men under his direction for some 15 years, directly, and some 15,000 more indirectly. The address has a portrait of Mr. Vreeland, and illustrates a number of instances of successful welfare work.

MR. G. T. HEWES.—The Independent Clearing House Company, which was organized some time ago to check telephone toll line message business and apportion the earnings of interchanged toll business, has secured a suite of rooms at 410 Locust St., Boone, Ia., and has engaged Geo. T. Hewes as manager. It is now starting its work. Arrangements have been made with a large number of Iowa telephone companies to have their business checked, and arrangements are fast being made with others for this same service.

MR. R. H. WATSON assumed charge of the Chicago office of the Gould Storage Battery Company as western manager on February 1, Mr. P. B. Yates, who formerly was at Chicago, having moved to the New York office. Mr. Watson is well known to the electrical trade through having been eleven years with the Gregory Electric Company as salesman, before that with the old Knapp Electrical Works. His territory will include all between Pittsburg and Denver, and his headquarters will be in the Rookery Building, Chicago.

MR. WILBUR H. TRAVER, formerly connected with the Rand Drill Company for a period of 12 years as manager of the Chicago territory until the consolidation of the Ingersoll Rand Companies, after which time he was manager of the railroad department with headquarters in Chicago, has now severed his connection with the Ingersoll Rand Company, and has accepted service with the Chicago Pneumatic Tool Company as manager of the mining and contract department. Mr. Traver will devote his time and attention principally to the sale of air compressors, rock drills and mining machinery.

MR. W. H. VORCE, general manager and treasurer of the recently organized Vermont Power & Manufacturing Company, which developed the electric plant at Fairfax Falls and furnishes light and power to St. Albans, Vt., has resigned the position of general manager and entered the employ of the American Optical Company. He will have charge of its lighting, heating and power department at Southbridge, Mass. Mr. Vorce will retain the office of treasurer of the Vermont Power & Manufacturing Company until other plans are made. He has also resigned the position of general manager of the St. Albans Street Railway Company, but will for a time continue as receiver.

MR. C. S. BRADLEY has been appointed to an acting professorship in the department of chemical practice in the Carnegie Technical Schools, Pittsburg. This engineer and inventor is well known in the electrical field, and his career has been noted in these pages. His devices and processes in electro-chemistry alone include more than 70 patents, and he is closely associated with the fundamental work in the reduction of aluminum and the fixation of atmospheric nitrogen. His inventions are also of very early date in regard to electric lighting, electric generators, transmission systems, rotary transformers, electric furnaces, etc. Beyond question the students in the schools will find great stimulus from contact with a mind so fertile and alert.

Trade Publications.

LIVE CONSTRUCTION MATERIAL.—Bulletin No. 17 of the Kellogg Switchboard & Supply Company, Chicago, Ill., contains a condensed price list of the main items used in the outdoor construction of telephone lines.

WATER WHEEL GOVERNORS.—Bulletin No. 8 of the Ludlow Valve Mfg. Company, Troy, N. Y., contains a description of a new type of vertical water wheel governor. The bulletin also announces the consolidation of the Sturgess Governor Engineering Company with the Ludlow Valve Manufacturing Company.

AIR COMPRESSORS.—Bulletin No. 30 of the Bury Compressor Company, Erie, Pa., gives much valuable information on the properties of air under pressure, and describes in detail duplex and compound air compressors of the steam and belt-driven types. The belt-driven machines are especially adapted to operation with electric motors.

HAMMERS.—The David Maydole Hammer Company, Norwich, Chenango Co., N. Y., has issued an exceedingly well-executed catalogue describing solid crucible-cast steel hammers. In a pocket-size catalogue also issued by this company, there are contained decriptions of the principal varieties of hammers which it now manufactures, to which is added much useful information for mechanics and others.

LATH MILLS AND BOLTERS.—Bulletin No. 1704 of the Allis-Chalmers Company, Milwaukee, Wis., is devoted to lath mills and bolters, the descrpition of each machine being accompanied with an illustration showing its working parts. One of the machines is provided with ten saws 22 inches in diameter. The smallest machine shown is equipped with a single 12-in. saw which runs at a speed of 1,700 r.p.m

TELEPHONE TRANSMITTERS.—The Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., has issued an exceptionally neat folder describing in detail its new type of telephone transmitter which has been designed to give soft and pleasing transmission over short distances, and still be capable of transmitting speech over very long lines with the least possible exertion on the part of the speaker.

MISSOURI AMERICAN ELECTRIC COMPANY, of 3327 Locust Street, St. Louis, Mo., has just issued a handsome, illustrated little pamphlet in regard to its Miller incandescent lamps, and its McDonnell controller, electric bell ringing device and electric sign flasher. Details are given as to all these, and special note is also made as to the patent arrangement with the General Electric Company on the Miller lamps.

ADDING MACHINES.—The Felt & Tarrant Manufacturing Company, Chicago, Ill., has issued an illustrated folder calling attention to the new duplex "comptometer." This machine is so constructed that the operator may strike at one time as many keys in separate columns as are convenient. This eliminates errors which may occur on other key-operated machines when the operator fails to depress each key in independent time.

RECORDING PRESSURE GAUGE.—An illustrated circular recently issued by the American Steam Gauge and Valve Manufacturing Company, 208 Camden St., Boston, Mass., gives a brief description of the American combined pressure and recording gauge. The value of a recording gauge to steam plant is aptly expressed in the following sentence: "The recording gauge is to the coal pile what the time clock is to the pay roll."

HYDRALIC TURBINES.—An illustrated folder recently received from the Trump Manufacturing Company, Springfield, Ohio, in addition to containing a brief description of various types of turbines for different duties, contains several tables showing the power which can be obtained from the turbines of different diameters when operating under specified heads and using a certain volume of water. The turbines vary in size from 25 hp to 932 hp.

STEAM SPECIALTIES.—The 1906 illustrated catalogue and price list of the Lunkenheimer Company, 221 E. Eighth Street, Cincinnati, Ohio, is a 472-page publication filled with much information of value to the steam engineer. In addition to describing brass and iron valves, whistles, cocks, gauges, injectors, lubricators, oil pumps, oil and grease cups, etc., adapted to the requirements of all classes of machinery, the book contains a 30-page section devoted to tables and useful data.

POWER PLANTS.—Bulletin No. 3 of the A. D. Granger Company, 95 Liberty Street, New York, gives a description of the methods used by this company when acting as contracting engineers in the erection of com-

plete power plants, including steam and electrical transmission for industrial and manufacturing projects, hotels, office buildings, apartment houses, central station and isolated lighting and power installations. Numerous views are given of completed installations and of component parts, such as boilers, engines and generators.

ELECTRICAL WIRES AND CORDS.—The 1906 catalogue of the Belden Manufacturing Company, 194 Michigan Street, Chicago, Ill., is a well prepared booklet containing 31 pages giving valuable reference tables of copper and German silver wires, in addition to describing switchboard and jumper wire, flexible telephone and electrical cords, self-fluxing solders, bare and tinned copper wires, bare German silver wire, electromagnetic winding, braided sleeving, electromagnet winding machines and revolution registers.

AUTOMATIC SPRINKLERS.—A recent catalogue of the Manufacturers' Automatic Sprinkler Company, 56 Liberty St., New York, gives an interesting description of automatic sprinkler protection. The sprinkler equipment consists of automatic sprinkler heads, valves, pipes and other appliances to protect buildings against loss by fire. The automatic sprinkler head consists of a valve held in place by fusible solder, to be released by the action of heat when fire occurs. The solder melts at temperatures varying from 165° F. to 400° F., according to the normal temperature of the space protected.

CLEATS.—The Blake Signal & Mfg. Company, 246 Summer St., Boston, Mass., has issued an illustrated folder dealing with insulated staples and compressed cleats. An extract from a letter received by the company from Prof. A. B. Smith serves to show how these articles are being received. "The cleats seem to be what I have often longed for when directing work in the field. For many places these are superior to your very excellent saddle staples, as where it is necessary to run the wires on lath and plaster work. They are superior to the staples in that they may be removed subsequently without damaging the insulation."

THE CLEVELAND RUBBER WORKS of the Mechanical Rubber Company have long been known to consumers of packing by the success of their "Saturn" sheet packing and "Jupiter" rod packing. Now, however, their packing business has grown so large and varied that the necessity has arisen for a trade-mark that shall identify all their packings. They have adopted the trade-mark "Marco." This trade-mark, as we understand it, does not supersede the old brands but is attached to all their packings, coupled with the well known names. This company has in the press a new packing catalogue descriptive of their complete line of packings, which will be sent upon application.

STEAM SPECIALTIES.—The Crane Company, Chicago, Ill., has just issued the following advance circulars, which are quite interesting, and contain a great deal of valuable up-to-date information: No. 01, steam and oil separators; No. 2, "Butterfly" hot-water radiator valves; No. 3, easy cutting pipe dies; No. 4, renewable spring disc valves; No. 5, combination back pressure and exhaust relief valves; No. 6, extra heavy flanged pipe joints; No. 7, various styles of Crane joints used in attaching flanges to wrought pipe; No. 8, automatic exhaust relief valves; No. 9, "Craneweld" flanged pipe joints; No. 10, reversible stop and waste cocks; No. 11, brackets, hangers, supports, rolls, and anchors; No. 12, "Cranetilt" non-return and direct-return steam traps; No. 13, pipe hangers; No. 14, balanced, unbalanced and swivel expansion joints; No. 15, drip pockets; No. 16, railing fittings; No. 17, lever-handle, quick-opening hot-water radiator valves; No. 18, emergency and automatic stop valves; No. 19, sediment traps; No. 20, pipe bends; No. 21, "Cranejunior" and "Cranesenior" steam traps.

News of the Trade.

COLUMBIA LAMPS are in excellent demand all over the country and several changes have been made to meet the situation and the prospects. At Memphis, Tenn., the office of the Columbia Incandescent Lamp Co. has been moved from the Scimitar Building to 480 Randolph Building to provide better facilities for the growth of orders in that vicinity.

THE DIEHL MANUFACTURING COMPANY, of Elizabethport, N. J., has opened a new office in Chicago at 207-211 East Jackson Boulevard. The office will be in charge of Mr. Hayden Hobart Smith and will be a distributing point for the West and Northwest of the well-known apparatus made by this company. A complete line of fans and motors will be carried.

THE INTERNATIONAL TELEPHONE MFG. COMPANY, Chicago, it is reported, is having remarkable success with its "leader," the new permanently adjusted bi-polar receiver. It is said that furnishing these to small and large buyers alike at a uniform low price has proved one of the best methods that could be adopted for more widely introducing "International" apparatus.

OHIO ELECTRIC WORKS.—The partnership between A. C. Fletcher and H. M. Buchman, under the name of the Ohio Electric Works at Cleveland, O., was dissolved on January 29 by limitation; Mr. Buchman retiring and Mr. Fletcher assuming every obligation. The wholesale department of the business will have increased attention in the future, and the interests of dealers in the trade will be protected. The new catalogue and discount sheets are now ready to distribute and can be had on application.

CEDAR POLES.—In pursuance of a resolve made many years ago to retire from active business at his present age, Mr. E. H. Valentine, president of The Valentine-Clark Company, Chicago (cedar poles, etc.) has disposed of his interests in said company to Mr. E. L. Clark, formerly secretary and treasurer, and who now succeeds him as president, the corporate name of the company continuing as heretofore. The Valentine-Clark Company has long occupied a commanding position in the cedar industry, and enjoys an extensive volume of business in all line of electric construction requiring the use of poles for power transmission. Mr. Clark has been identified with the company since its formation, possesses an extensive acquaintance with producers and consumers, as well as an intimate knowledge of the trade in all its details.

ELECTRIC GOODS MANUFACTURING CO.—Mr. H. C. Thomson, vice-president and manager of the Electric Gas Lighting Company, has issued the following circular notice, which is not without a special interest to many of those who have watched the growth of the concern for so many years: "During an active career of a quarter of a century the name 'Electric Gas Lighting Company' has become historical and we believe a synonym of quality and business integrity throughout the country. This name at one time indicated the nature of the business of our company, but it no longer describes the varied and extensive lines now manufactured by us and carried in our large jobbing business. We have, therefore, although with much reluctance, decided to end the confusion caused thereby, and have incorporated under the name of 'The Electric Goods Manufacturing Company and will do business under that style on and after this date, February 1st. No change whatsoever in the policy or personnel of the business will be made. We shall endeavor as hitherto, as regards our output and methods, to keep in the front rank both in the manufacturing and in the jobbing departments."

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JANUARY 30, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

810,897. APPARATUS FOR COMPOUNDING TIN; Charles E. Acker, Niagara Falls, N. Y. App. filed June 8, 1903. An apparatus for producing chlorine compounds of tin, comprising a dissolving vessel for effecting a solution of the tin and a reaction tower, and means for circulating the solution through said dissolving vessel and the reaction tower.

810,912. AUTOMATIC NON-INTERFERING REPEATER FOR FIRE-ALARM CIRCUITS; Frederick W. Cole, Newton, Mass. App. filed Jan. 31, 1905. Details of construction of repeater having a locking magnet by which it is prevented from repeating any signal until the preceding signal has been concluded.

810,914. PROTECTIVE APPARATUS; Frank B. Cook, Chicago, Ill. App. filed Dec. 4, 1903. A thumb or protector for telephone circuits having certain detail features of construction, including a pair of superposed springs mounted flatways upon a ground plate, but insulated from the same and from each other.

810,915. AUTOMATIC CUT-OUT MECHANISM FOR ELECTRICALLY OPERATED BULK-HEAD DOORS; William B. Cowles, Cleveland, O. App. filed July 11, 1904. The transmission gearing from the motor to the bulkhead includes a gear driven by a connection capable of relative rotative movement under the torque stresses. In case the bulkhead encounters an obstruction, the increasing torque produces a relative angular movement which opens the motor's circuit.

810,929. STORAGE BATTERY; William Fennell and Wm. O. Perry, Leytonstone, England. App. filed Mar. 17, 1904. A storage battery comprising a honeycombed mass, an active material on the exposed surfaces of said mass, and an unobstructed passageway formed therein in addition to the interstices of the mass, for the purpose of facilitating the egress of gases.

810,930. STORAGE BATTERY; William Fennell and William P. Perry, Leytonstone, England. Filed Mar. 6, 1905. An electrode comprising a non-conducting mass insoluble in electrolyte and pierced in more than one direction with inter-communicating passages, the walls of the passages being lined with active material.

810,931. ALARM FOR INCUBATORS; Williard S. Freeman, St. Cloud, Minn. App. filed May 6, 1904. A lever on top of incubator is connected with a thermostat within and serves to operate alarm circuits in case the temperature becomes greater or less than certain fixed values.

810,958. END CELL SWITCH; Lamar Lyndon, New York, N. Y. App. filed Oct. 17, 1904. Provides means for automatically cutting in or out the end cells of a storage battery depending on their electrical condition.

811,017. PROCESS OF MAKING MANTLES; Oscar Wiederhold, Jersey City, N. J. App. filed Mar. 6, 1905. In order to avoid the unfavorable influence of dust and iron particles caused by the knitting of Welsbach mantles, the fabric is bleached after being knitted into shape, rather than before, as previously.

811,029. TELEPHONES FOR SHIPS, MINES, ETC.; Arthur F. Boardman, Sommerville, Mass. App. filed Apr. 10, 1905. Detailed construction of a telephone apparatus with a receiver, transmitter and several push button calls, all enclosed in a circular case and adapted for use on ship board.

811,037. DANGER SIGNAL; William C. Creveling, St. Louis, Mo. App. filed Dec. 8, 1904. A storage battery on the car is maintained charged by the power circuit so as to be effective to illuminate a danger signal in case the car is stalled by the failure of the power circuit.

811,052. TELEPHONE CALL; Peder T. Guyerman, Brewster, Minn. App. filed Mar. 14, 1905. A normally closed selecting circuit including a contact spring and a revoluble wheel which is stepped around by a pawl and ratchet mechanism so as to make the desired local circuit.

811,063. ANNUNCIATOR; Walter R. Horning, Cleveland, O. App. filed Dec. 5, 1904. In an annunciator, the combination of a pivoted shutter, a vibratory retaining and releasing device for said shutter comprising a pair of forks adapted in one position of said device to permit the passage there between of the adjacent portion of the shutter and in another position to engage such portion of the shutter, and means for vibrating said device.

811,064. AIR BRAKE; Edwin T. Hughes, Gladstone, Col. App. filed Oct. 9, 1905. In order to avoid exhausting the auxiliary cylinders at service applications of the brake, the service applications are made by an electro-magnet so that the train pipe pressure is not reduced and remains effective to keep the auxiliary reservoirs charged.

811,083. ANNUNCIATOR; Halvor M. Olsen, Chicago, Ill. App. filed May 16, 1901. Comprises an electro-magnet, two plates separated by four short members and rigidly connected with the forward end of the magnet, and a convex cap secured to the outer of said plates and provide with an opening, a pivoted target arranged back of said cap and an armature having a forwardly extending arm adapted to engage said target.

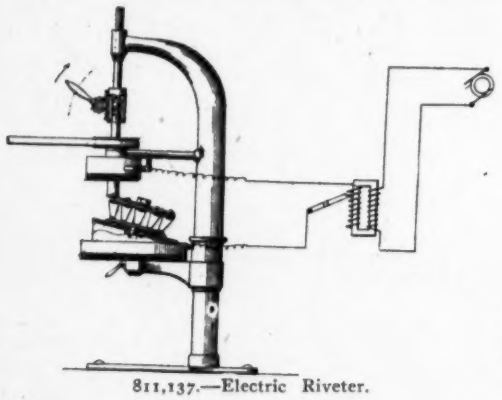
811,088. ELECTRIC DRYING AND IRONING APPARATUS; George W. Richardson, Wissahickon, Pa. App. filed Mar. 28, 1905. A series of presser rolls geared together and provided with internal heating coils.

811,098. TELEPHONE TRANSMITTER; Michael Setter, Chicago, Ill. App. filed Dec. 30, 1904. Details of a telephone transmitter having a front plate composed of two sheet metal parts pressed into the desired shape and rigidly secured together, one of said parts having a boss to which the mouthpiece is secured.

811,101. ELECTRIC SURFACE AND ELEVATED TROLLEY RAILWAY; Charles D. Smith, Fond du Lac, Wis. App. filed Mar. 2, 1903. The third rail is laid between the usual tracks and has an inverted V-shaped housing thereover, the two walls of which are capable of separating at their apex so as to connect the passage of the usual collector shoe on the car.

811,105. RAILWAY SIGNALING; Samuel D. Strohm, Philadelphia, Pa. App. filed Aug. 29, 1891. The track is provided with contact plates and cam inclines which engage a depending lever upon the train. The lever is moved in one direction or the other depending on the direction of the train, and different alarm circuits are completed by the contact plates.

811,127. TELEGRAPHY AND TELEGRAPH APPARATUS; John Burry, New York, N. Y. App. filed Oct. 7, 1893. A complete printing telegraph system having a piano transmitter with 80 key characters, each one of which makes a different combination of three impulses of different signs and polarities. The receiving instrument has six notched bars, different combinations of which are moved by the received impulses, so that the appropriate key falls into the aligned notches.



811,137.—Electric Riveter.

811,137. ELECTRIC RIVETER; Samuel Eveland, Philadelphia, Pa. App. filed Sept. 13, 1904. A riveter comprising a form of sensitive drill in which an electric circuit is complete at the point of the revolving tool. The rivet is heated by the current and headed by the combined pressure and rotation of the tool.

811,140. TELEPHONE OR OTHER BOOTH; Edythe P. Garney, Scranton, Pa. App. filed Apr. 1, 1905. A telephone booth having a ventilating opening and a sound breaking device located in such opening and including an exhaust fan.

811,153. TROLLEY POLE; John E. Lagergren, New York, N. Y. App. filed May 25, 1905. The trolley wheel is journaled on a supplemental arm or lever whose relative movement when the pole leaves the wire is effective to apply a brake or lock which prevents upward movement of the pole.

811,154. DYNAMO ELECTRIC MACHINE; Pierre A. J. Lapeyrade, Paris, France. App. filed Feb. 8, 1904. In a dynamo electric machine the combination of means for producing a magnetic field, a stationary armature and windings therefor so placed as to always lie in the magnetic field, a revoluble armature and windings therefor adapted to enter and leave the magnetic field during the movement of revolution and means for supporting the fixed and revoluble parts.

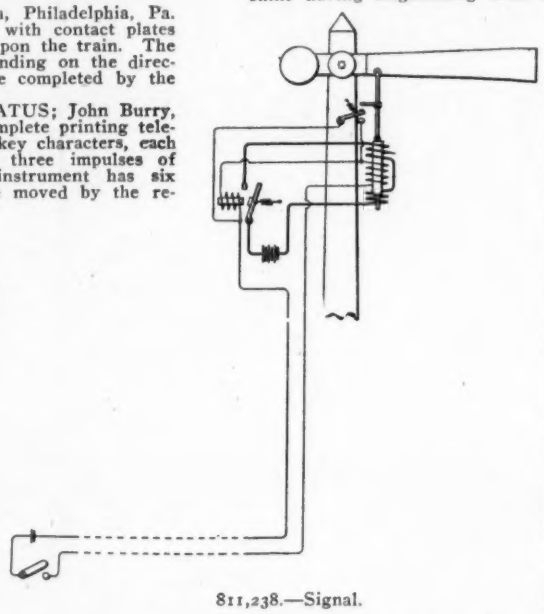
811,161. INCANDESCENT LAMP SOCKET; Normal Marshall, Newton, Mass. App. filed Mar. 31, 1904. The socket is made of two sheet metal parts, one of which has circumferentially spaced openings and the other of which has correspondingly spaced spring tongues which enter said openings to lock the parts in proper relation.

811,186. CLEAT AND SOCKET; Charles M. Waite and Charles F. Fralick, New York, N. Y. App. filed Apr. 14, 1904. A cleat and socket comprising a two-part cleat and a socket carried by one side of said cleat, and a pair of weather-proof rings, one of which lies between one of said terminals and the walls of said socket, and the other of which encircles said socket.

811,266. LIGHTNING ARRESTER; Walter C. Jones, Chicago, Ill. App. filed Dec. 7, 1901. In a lightning arrester, the combination of two continuous paths for the current, a non-inductive resistance arranged in one of said paths, and an arrester coil and a resistance arranged in the other path.

811,231. ALTERNATING CURRENT MOTOR; Benjamin G. Lamme, Pittsburg, Pa. App. filed June 30, 1904. An electric motor having armature and field magnet pole pieces provided with slots parallel with the armature axis, a neutralizing winding located in said slots and connected in series with the armature winding and low resistance plates located in the inter-polar space.

811,238. SIGNAL; Karl Moller, Charlottenburg, Germany. App. filed June 12, 1905. The semaphore arm is operated by a solenoid in a local circuit controlled by a relay magnet operable from the distant station. The arrangement is such that the local circuit is energized only for the movement of the solenoid core, the more feeble current from the transmitting station being sufficient to hold the arm in position after it has once been raised.



811,238.—Signal.

811,247. ELECTRICALLY OPERATED TYPE WRITER; Willis J. Roussel, New Orleans, La. App. filed Mar. 28, 1903. Details of a key wheel typewriter having a type wheel which is positioned by a power magnet, and a magnet operated stop which swings into position after a predetermined movement of the wheel.

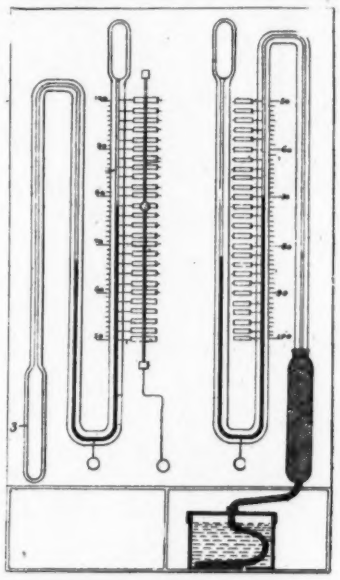
811,253. SOCKET FOR INCANDESCENT ELECTRIC LAMPS; Albert P. Seymour, Syracuse, N. Y. App. filed Jan. 30, 1905. Details of construction of a socket having two porcelain blocks, one of which carries the spring contacts, and the other the contact plates, and between which is journaled the cam by which the springs are separated to complete the circuit.

811,265. PROTECTION AGAINST REVERSAL OF ENERGY; Leonard Wilson, Pittsfield, Mass. App. filed May 2, 1904. A main alternating current circuit, a device energized by a constant flux, means for producing in said device a second flux, reversible in direction when the current in the main circuit reverses in phase relative to the electro-motive force, and a switch in said main circuit controlled by said device.

811,277. ELECTROMAGNET; Fred B. Cory, Schenectady, N. Y. App. filed July 15, 1004. Two separate semaphore arms are operable by the same power magnet by virtue of a pair of selector magnets which respectively engage the separate semaphore arms.

811,304. ALTERNATING CURRENT MACHINE; Marius C. A. Latour, Paris, France. App. filed June 25, 1904. A multipolar field magnet, a wave armature winding, a commutator composed of alternate live and dead segments, and a plurality of brushes of each polarity distributed around said commutator, the width of a brush being not greater than a segment.

811,312. DYNAMO ELECTRIC MACHINERY; John H. St. H. Mawdsley, Taunton, England. App. filed Nov. 30, 1903. A dynamo electric machine having magnetizing coils each surrounding a pole piece, placed with their sides in the neutral zones and close to the armatures and at or about the middle of the interpolar spaces of contiguous poles and spaced away from the pole cores.



811,383.—Hygrometer for Regulating Humidifying and Heating Systems.

811,340. ATTACHMENT FOR ELECTRIC CONTROLLERS; Ferdinand Volk, Pittsburg, Pa. App. filed Sept. 12, 1905. The usual controller handle has a permanently connected cam plate with inclined teeth or notches thereon, providing a sinuous passage there between. The arrangement is such that a detent on the controller handle must be manipulated to pass each notch in starting, but the controller handle can be moved freely to off or zero position.

811,364. OZONE GENERATOR; Charles F. Birtman, Chicago, Ill. App. filed June 9, 1905. An apparatus for generating ozone including a generating chamber and two sets of circuit terminal windings in said chamber, the terminal windings of one set alternating with those of the other, and a source of electric supply comprising conductors each of which has parallel connections with the circuit terminal windings of one set within the generating chamber.

811,375. WIRED PLATING AND DIPPING BACK; James P. Clark, Newark, N. J. App. filed June 26, 1905. Has a center bar with a series of transverse bars secured thereto and a series of hooks supported by one of said transverse bars, and protected conducting wires in electrical connection with said hooks and with a suspensory conducting wire.

811,383. HYDROMETER FOR REGULATING HUMIDIFYING AND HEATING SYSTEMS; Stuart W. Cramer, Charlotte, N. C. App. filed Dec. 28, 1904. An apparatus for automatically regulating the air humidity comprising a dry and wet bulb thermometer in the tubes of which are fused a series of platinum terminals. The electric circuits are so arranged as to open or close the moist air dampers depending on the relation of the mercury in the respective tubes.

811,405. ELECTRIC MOTOR; Paul Jigouzo, Vanves, France. App. filed Oct. 18, 1904. An arrangement for automatically starting polyphase motors with a rotating field, in which the current is induced in the armature by short circuiting its coils, including a series of conducting rings adapted to short circuit the armature, and a series of flexible conductors adapted to short-circuit said rings by centrifugal force.

811,415. REGULATION OF ELECTRIC MOTORS; Johan G. V. Lang, London, England. App. filed June 28, 1904. By the ordinary regenerative system the motorman is required to vary the position of his controller in order to secure the proper braking effect for the different speeds. In order to avoid depending on the motorman who is uncertain for this purpose, the patentee provides an automatic system for properly connecting the motors.

811,519. ELECTRIC SWITCH FOR STREET RAILWAYS; Jones A. Posey, Midlothian, Tx. App. filed Mar. 14, 1905. The switch point is moved by a connection from a shoe adiacent the track rails which is depressed by the approach of a car. The direction in which the switch point moves is determined by a pair of selector magnets operated by a special trolley circuit, and under the control of the motorman.